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SCIENTIFIC THIEF-CATCHING.

One of the early applications of electricity was in watchman duty, and it is still our main dependence for burglar and fire alarms. Now, however, it has been called in for detective service. The daily press reports that the Mikado of Japan has ordered a complete outfit of Rœntgen-ray apparatus, to be used in examining suspected employés for concealed coins. The Japanese mints have been systematically robbed for some years by employés who swallow newly minted coins, but up to this time Oriental ingenuity has not been able to put a stop to this. Therefore science has been called in. Provided with the Rœntgen-ray apparatus, the officials of the mint will be able to detect coins about or within the employés, and they may therefore feel assured that at last the ways that are dark will be lighted, and the tricks of the thieves with gold-swallowing tendencies will become vain.

PROGRESS IN ELECTRICAL DESIGN.

In describing the transmission plant between Hochfelden and Oerlikon, which has been changed over from 15,000 volts to 30,000 volts, the London *Electrician* gives some exceedingly interesting figures, showing the progress in transformer design during the past ten years.

When the plant was first installed, transformers having a capacity of 200 kilovolt-amperes were used, these having a total weight of 1,045 pounds. The weight of the copper was 342 pounds, and that of the iron core 200 pounds. The efficiency of a transformer was seventy-nine per cent, and the maximum drop of voltage was seventeen per cent. These transformers, which were designed by the Oerlikon Company, have been replaced by a newer type also constructed by this company, and which are designed to be used on 50,000-volt circuits. At present, however, they are operated at 30,000 volts only. The output of one of the newer transformers is 450 kilovolt-amperes. The total weight is 845 pounds, the weight of the copper is 100 pounds, and the weight of the iron core 555 pounds. The efficiency of these transformers is ninety-seven and one-half per cent, and the maximum drop of voltage is but three per cent.

A comparison of these figures shows how great has been the improvement in this last decade. The early type of transformer had a weight of over five pounds per kilovolt-ampere. The copper used in this type was 1.7 pounds per kilovolt-ampere, and the corresponding weight of the core one pound. In the newer type the total weight has been reduced to something less than two pounds per kilovolt-ampere, the weight of the copper to less than a quarter of a pound, and the weight of the iron core increased to one and one-quarter pounds per kilovolt-ampere. This is certainly a striking instance of careful study and design. Although the total quantity of material used has been reduced, the output of the transformer has been more than doubled, the efficiency has been increased, and the loss of potential made less than one-fifth of that in the older type.

Although these figures relate to transformers only, there is little doubt that a comparison of the machines designed to-day with those designed ten years ago would show a similar improvement.

MUNICIPAL TELEPHONY.

An old contention which seems to be losing ground is the agitation which has for a long time been working toward the municipal control of telephone exchanges. In a number of instances several exchanges which started out under municipal management with the fairest of conditions back of them have, within a short time, given up the ghost, and their lines either been bought by the competing company or have lapsed into disuse. Not only in the United States has this been the case, but only recently have we been confronted by the spectacle of the Tunbridge Wells corporation selling out to the National Telephone Company, of London, England. It is being realized more to-day than ever before that it requires a combination of minds to effect a profitable plan for the working out of a system of telephone service. Capital requires the aid of technical knowledge, and technical knowledge requires the assistance of practical mechanics. The practical mechanic, the technician and the capitalist place their combined facilities at the disposal of good business sense, and this combination is one that, although always available, is rarely found in a department of municipal control. When the ghost of municipal control for this class of service has been finally and completely laid, it will be a better day for all of us.

THE OLD YEAR AND THE NEW.

The year just closing has been a prosperous one for electrical industries, and the ELECTRICAL REVIEW has come in for its full share of the good times. It has grown in influence, in size and in circulation, and perhaps we may be permitted to flatter ourselves that this has not been entirely undeserved.

It has been our endeavor to present promptly to our readers all electrical news. A systematic effort has been made to report promptly and fully all conventions of electrical societies, and our efforts in this direction have placed us almost alone. Our staff of contributors has been increased, enabling us to present to our readers interesting articles prepared by specialists in all of the many branches of the industry. In the coming year there will be a still greater effort made to secure valuable matter for our columns. Scientific developments, as well as industrial applications, will be closely watched, and every happening of interest will be noted.

Our growing business has necessitated an increase in our capitalization and in our staff. Offices are now established in Chicago and London, and staff contributors are located in Paris and Berlin, keeping the ELECTRICAL REVIEW in close touch with all matters electrical in this country and abroad. It is not too much to say that nothing of interest in electrical matters happens in any part of the world without its being promptly reported in the ELECTRICAL REVIEW. Moreover, the columns of our journal are closely watched, and anything which appears there can not fail to be noticed and read by an ever-increasing list of subscribers. Our subscription list shows an increase of nearly sixty per cent during the year just closing. The forecast for the new year points to a continued prosperity in the electrical industries and an even greater growth of the ELECTRICAL REVIEW than during this year.

To handle this increase effectively no effort will be spared. The same policy which has brought this journal to its present important and influential position will be adhered to. The work for the new year will be taken up with renewed energy, and the ELECTRICAL REVIEW is looking forward with pleasure to a still wider acquaintance and a larger army of friends.

ELECTRICAL POWER IN MINING.

At the recent convention of the California Miners' Association, at San Francisco, Mr. John B. Tregloan presented a paper in which he discussed the use of electric power in mining. Fuel of all descriptions is expensive in this state, and the mining operators have found the use of electric power not only better than steam or water power, but even less expensive.

A case is mentioned where one company saved $150 per month using electric power at $6.50 per horse-power-month, as compared with water under a head of 185 feet, at twenty cents per miner's inch. In another case a steam plant was replaced by motors, and the cost of driving the blower, in this way, was one-half of what it had been when using steam. It has even been found economical to use motors to drive the air compressors when air is used for operating tools throughout the mine.

The many advantages of electric motors in milling plants were pointed out, and the author brought his paper to a close with an enthusiastic tribute to electricity "which lays down power at our very door already harnessed for work—the greatest and most efficient power the world has ever known."

CHRISTMAS.

The season of good fellowship and good cheer is at hand, and before another issue of the ELECTRICAL REVIEW appears a new year will have been ushered in. We take this opportunity of wishing for our readers, throughout the world, the merriest of Christmases and the happiest and most prosperous of New Years.

A NEW SYSTEM OF WEIGHTS AND MEASURES.

At the recent meeting of the American Society of Mechanical Engineers, Professor Sidney A. Reeves, of the Worcester Polytechnic Institution, proposed a new system of weights and measures, or rather a revision of our present so-called English system. The mechanical engineers are so wedded to the foot and pound as standards of distance and weight that they seem willing to go to almost any extreme to preserve these. It is hardly necessary to observe that these units have many advantages, but they have some disadvantages as well, as, indeed, has any conceivable system.

The unit of length proposed for this new system is the English yard. This is divided into twelve parts, each of these into twelve parts, and so on. The smaller units of length then become, as measured by our present system, three inches, one-quarter of an inch and one-forty-eighth of an inch. Distances less than a quarter of an inch would then be expressed as multiples of forty-eighths, and would compare unfavorably with the simple fractions of one-eighth, one-sixteenth, etc. To avoid this objection and to simplify the system as far as possible, Mr. Reeves proposes that we abandon our present decimal system and replace it by a duodecimal system. Two new digits are introduced between nine and ten, giving us eleven digits in place of nine. With this revision, the term "ten" would signify one dozen units, while "one hundred" would be one hundred and forty-four units, as at present reckoned.

This system shows a number of convenient coincidences. For instance, one thousand yards on the duodecimal system —which is equivalent to one thousand seven hundred and twenty-eight yards, as expressed in the decimal system— closely approximates one statute mile. Again, a cube of water three inches square, or a unit cube, in the new system weighs very nearly a pound. These coincidences are happy, not only because they would facilitate the introduction of the new system, but because past experi-

ence has shown that these units are of convenient size.

By the new system, the fractions of an inch now in general use can be expressed as simple decimals. Thus, one-quarter of an inch becomes one-hundredth of a yard, and one forty-eighth becomes one-thousandth, expressed duodecimally. An eighth is therefore six thousandths, and one-sixteenth is three-thousandths, and so on.

Theoretically the duodecimal system is very pretty, and its advantages have been pointed out at different times by pure mathematicians. The present decimal system labors under a disadvantage, as the periods are divisible by but two digits —two and five—while in the duodecimal system the periods are divisible by no less than four digits. It is claimed that this advantage of the duodecimal system would simplify wonderfully mathematical computations. Indeed, if we could believe all that has been said in favor of the duodecimal system, its adoption in place of the present system would have made us all lesser Newtons, and mathematics would be considered a pleasure and present no terrors to the average mind. What a pity that our simian ancestors did not realize the burden they were transmitting to posterity, and while they were about it develop a sixth finger on each hand.

In spite of the many advantages claimed by Professor Reeves for this system, the practical obstacles which have to be overcome seem almost insurmountable. We have seen how vigorously the mechanical engineers can combat a proposed change in our present system of weights and measures, and even could they be counted upon to act as a unit in favor of the proposed change, there would still be the vast majority of the non-technical public which would object just as strenuously to any change in our system of enumeration.

FRENCH AND GERMAN.

Not long since a prominent English engineer stated that the study of French and German by engineers was a waste of time. We have recently received a letter from abroad which calls attention to the handicap under which Americans work, due to a lack of knowledge of these languages. The American can hardly expect to compete with the German if he can not talk directly to his possible customers. The Germans have realized the importance of this, and always send to foreign countries men who speak the language of the country to which they are sent. Our correspondent thinks that the two languages of the commercial world to-day are English and German, and that a knowledge of these two languages would enable a man to get along in almost any part of the world.

While our correspondent is looking at this matter from the commercial side, it is equally as important to the engineers, because they must be familiar with foreign practice to enable their products to compete with those of other countries, and it is as difficult for an engineer who can read no foreign language to keep in touch with foreign practice as for a sales agent who does not speak French or German to sell his goods in competition with men who are better prepared.

Often one hears the query, "Why have electrical methods spread so rapidly?" and the popular opinion seems to be that there is an unseen virtue in electricity, making all things possible for it. The true reason is not hard to perceive. Electricity is simply a means to an end. In itself it is not a source of power nor wealth, nor is it the end sought in any case; but in a vast majority of cases it unquestionably furnishes the best means by which to accomplish the desired result.

Electricity occupies a position not unlike that of money, for by means of it energy in unuseful forms is easily transformed into useful forms, just as in commerce by means of money one readily converts merchandise which is not available for his own uses into available forms.

It would seem that the flying machine will be needed to give satisfactory rapid transit to Manhattan Island. This narrow strip of the earth's surface is not equal to the demand for room for houses, railway tracks and moving people. Nor is it likely that subways or elevated roads can equal the demand of this distressing congestion. The flying machine invention will be welcome.

HIGH TEMPERATURE ELECTROCHEMISTRY—NOTES ON EXPERIMENTAL AND TECHNICAL ELECTRIC FURNACES.

BY R. S. HUTTON AND J. E. PETAVEL.

PART II.

NOTES ON TECHNICAL PROCESSES.

In the comparatively short time which is at our disposal it would be altogether impossible to give any adequate account of the general development of the industry. We shall, therefore, neither touch on the historical side of the subject which has already been fully treated by others, nor do we propose to give a complete account of the methods in use in such widely developed industries as calcium carbide, aluminum, etc. Our object will be more especially to consider some of the newer industries, to draw attention to recent advances in the older ones, and to consider where possible the directions in which improvements are to be expected. In connection with each subject a few references are given which may be of interest to those desiring more complete information.

Calcium Carbide[1]—We have not here to deal with the economical side of the subject, but it may be said that the financial crisis through which the carbide industry has recently passed influenced very considerably its progress.[2] Previously the manufacture of carbide was being taken up in innumerable small factories with processes differing very largely as to their efficiency. The present circumstances have eliminated the less efficient methods, and the comparatively few firms which are still successful owe their advantage to the careful consideration they have given to the perfection of the mechanical details. Speaking generally, it may be said that the tendency, here as in other manufactures, has been to simplify the process as much as possible. The current regulation is automatic,[1] and is achieved either by raising the vertical electrodes when the "pot" type of furnace is used, or by some other means of bringing more resisting material between the electrodes.

[1] Vivian B. Lewes, *Acetylene*, London, 1900; Moissan, *Comptes Rendus*, vol. 115. 1.031, 1892. vol. 118. 501. 1894; Moissan, General Review of Chemistry of Carbides, *Rev. Générale des Sciences*, vol. 12, pp. 946-955, 1901.

[2] A careful estimate recently made points out that of the 254,000 horse-power installed for this manufacture, only some 64,000 horse-power is in use, *Mineral Industry*. p. 74, vol. 10, 1902.

[1] *E.g.* Horry, *U. S. Patent* 655,779 of 1900.

Means are frequently provided for automatic grinding, weighing and mixing of materials. With regard to the labor-saving problem, a continuous furnace possesses obvious advantages. A great deal of discussion has arisen with regard to the relative merits of the "continuous" and "discontinuous" furnaces, but this is largely due to a confusion of terms, since the tapping methods,[1] which undoubtedly give a poorer grade carbide, are by no means the only continuous ones; in fact with such furnaces as the Horry, Siemens and Halske, etc., all the advantages of a continuous process are attained, without the great loss of heat which is entailed by the removal of the molten carbide from the furnace. The production of calcium carbide being a purely electrothermal operation, either continuous or alternating current can be used, but the balance of advantage seems to be decidedly in favor of alternating current, which lends itself more easily to long-distance transmission. An alternating plant is, moreover, more suitable to withstand the sudden and intense variations in load, which it is at all times impossible to avoid, and the carbide produced is said to be more uniform in quality.[2]

Three-phase current, which has been employed notably at St. Marcello d'Aosta,[3] has the advantage of giving a more even distribution of temperature. It must be remembered that the most favorable temperature conditions are somewhat narrow,[4] and that too intense a heat can produce the phenomenon of "burning." Alternating current has, however, one serious disadvantage, namely, that the power-factor is somewhat low. Experience has shown that with a view to preventing both the inconvenience and loss caused by the dissipation of the finely divided material, it is necessary to have the furnace properly enclosed. This minimizes to a large extent the oxidation of the carbon electrodes, which is also an important question with regard to cost, and further enables the gases to be made use of for heating purposes. There seems to be a distinct gain to be achieved by finely dividing and intimately mixing the raw materials, and in modern enclosed furnaces these appear now to give very little trouble.

The carbide industry has reached a large development in the United States, where, at Niagara, some 15,000 horse-power are continuously in use. Although the distance of these works from the power-house is only about two miles, it has been found economical to transform the two-phase current, generated at 2,200 volts, to three-phase at 11,000 volts, the transformers being Scott connected and of 2,500-horse-power capacity. At this pressure the current is received at the transformer house close to the carbide works and transformed down, first to two-phase, 2,200 volts, then to 110 volts, at which it enters the furnaces.[1] At Sault Ste. Marie, a sister factory for 20,000 horse-power is nearly complete. A plan of the Horry furnace, given in Fig. 9, is of some interest, this being the type of furnace employed in these works.[2]

Of other furnaces, those of Gin and Leleux[3] and the Deutsche Gold u. Silber Scheide Anstalt[4] are among the most widely known, the former having been fitted up at Meran and in other parts of France and Italy, while the German firm has equipped several factories in Norway and elsewhere. The condition of the carbide industry is at the present time entirely dependent on the progress of acetylene lighting, and despite the unfortunate reaction caused by the flooding of the market by improperly constructed generators, now that the subject has received due attention and safe reliable apparatus is available,[1] steady progress is being made.

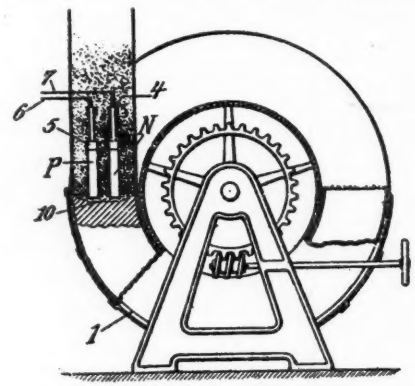


FIG. 9.—THE HORRY CALCIUM CARBIDE FURNACE.

The current passes between two vertical carbons P and N, which are fixed The enclosure containing the material is automatically lowered so soon as the mixture in the neighborhood of the electrodes has been transformed into molten carbide. This is effected by constructing the furnace in the form of a drum which rotates very slowly, heating is produced in a space formed by the wide flanges of the drum, the drum itself, and plates bolted on to the periphery; these metal parts are sufficiently protected by the unacted-on material. Diametrically opposite the heating zone, at the back of the furnace, the plates are unbolted and the carbide removed. This furnace combines several of the advantages of the continuous and discontinuous types; it is continuous in the true sense of the word since the power is never turned off, on the other hand the molten carbide is not removed until it has cooled down and imparted a considerable amount of its heat to the surrounding material. The speed of rotation of the wheel is regulated in such a manner as to keep the current approximately constant.

Possibly the application of acetone as a solvent for acetylene,[2] enabling it to be safely stored under pressure, may influence considerably its future.

Other proposals for the use of calcium carbide, which have not as yet come into general use, include its application as a metallurgical reducing agent,[3] and for the protection of the finer grades of lamp-black.[4]

With regard to the efficiency of the manufacture, an important advance would undoubtedly result from any invention enabling the heating power of the waste gases to be more generally used for preliminary treatment of the raw materials. The combination of the lime-kiln and the electric furnace would lead to a great economy of energy, but up to the present the practical difficulties have outweighed the theoretical advantage.

Refractory Metals and Their Alloys—The difficulties in the way of the commercial application of the electric furnace having been successfully overcome in the case of calcium carbide, efforts were soon directed to the possibilities of producing some of the rarer metals on a large scale in a similar type of furnace. The valuable qualities of some of these metals in the manufacture of steels ensured their finding a satisfactory market. Among these metals ferrochromium takes an important place, chiefly on account of the large employment of chrome steels for the manufacture of armor plate, projectiles, tool steels, springs, etc. At the present time, one factory alone in America is using 450 tons of seventy per cent ferrochromium a year for armor-plate work. For this country, data are not easy to obtain, but doubtless, owing to the advanced state of the British steel trade, large quantities of these alloys are employed. The chief factories are situated in France and the United States. The Willson Aluminum Company, with works at Holcombs Rock, Va., and Kanawha Falls, W. Va., manufactures ferrochromium and other alloys, using some 3,000 horse-power at the latter works; the furnaces they employ are suitable for tapping, the metals being run into iron-lined trucks, the automatic regulation as used in the carbide industry being also installed.

(To be continued.)

[1] Carlson, *Zeitschr. für Elektrochemie*, vol. 6. pp. 413, 429, 1900; Frölich, *Zeitschr. für Elektrochemie*, vol. 7, pp. 1-10, 1900.

[2] Pradon, *Electrical Review*, vol. 49, p. 463, 1901.

[3] Cesare Pio, *Electrician* vol. 43, p. 637, 1899; Bertolus, *Eng. Patent* No. 16,942, 1897; *Electrical World and Engineer*, vol. 40, p. 375, 1902.

[4] Rothmund, *Zeitschr. für anorganische Chemie* vol. 31, p. 136 1902; Borchers, *Zeitschr. für Elektrochemie*, vol. 8, p. 349, 1902.

[1] *Electrical World and Eng.*, vol. 34, p. 794, 1899.

[2] Horry, *English Patents* No. 22,521, 1897, and No. 14,261, 1899.

[3] Borchers, *Zeitschr. für Elektrochemie*, vol. 7, p. 236, 1900; Haber, *Zeitschr. für angew. Chemie*, 1901, p. 185.

[4] Kershaw, *Electrician*, vol. 46, pp. 164, 245, 267, 1900.

[1] *Report of Committee on Acetylene Generators* (Home Office), 1902.

[2] Fouché, *Soc. Francaise de Physique*, No. 171 (Nov. 15, 1901); *Journal de l'Electrolyse*, vol. 10, No. 122, p. 13, 1901.

[3] v. Kügelgen, *Zeitschr. für Elektrochemie*, vol. 7, pp. 541, 551, 573, 1901.

[4] Hubou, *Memoires de la Societe des Ingenieurs Civils de France*, 1900.

American Institute of Electrical Engineers.

"Braking and Traction Brakes" the Subject of the 171st Meeting, Held in New York City, December 19, 1902.

THE one hundred and seventy-first meeting of the American Institute of Electrical Engineers was held at No. 12 West Thirty-first street, New York city, on the evening of Friday, December 19, 1902.

The secretary reported the election of fifty-two associate members, and that Messrs. F. V. T. Lee and Henry Noel Potter had been transferred to full membership.

President Scott introduced the subject of the evening—"Braking and Traction Brakes"—in a brief address. In the development of transportation, the positive problems—those of starting and keeping the car in motion—were the first to attract attention. The negative problems of braking and stopping had been more or less neglected until recently. The hand brake, deemed satisfactory at first, has now been to some extent replaced by the air-brake with added efficiency. This is particularly true for city work, where stops are frequent and average speeds must be fairly high. A new feature of the braking problem, which is attracting attention, is the study of retardation. To increase a schedule speed with a given number of stops, it was necessary to increase the retardation as well as the acceleration. An increase in the rate of retardation from one mile per hour per second to three miles per hour per second would increase the schedule speed ten per cent, saving the passengers ten per cent of their time, and enabling the trains to carry ten per cent more passengers. The demands for the power brake have in some cases been supplied by equipping the trains with air-brakes. In other cases electric brakes had been installed. With the latter, two methods of application were possible. In the first the energy represented by the momentum of the car could be returned to the line by using the back torque of the motors for retardation, and in the second no attempt at saving energy is made, but a magnetic brake is applied either to the track or to the wheel. The flexibility of the electric system should be noted, as it can supply the means for braking the car as well as for moving it.

The first paper, entitled "Some Brake Tests and Deductions Therefrom," by Mr. J. D. Keiley, of the Brooklyn Rapid Transit Company, was, in the absence of the author, read by Mr. W. C. Andrews. This paper gives the results of some very careful experiments to determine the relative efficiencies of different types of brakes. In these tests the same type of cars was used. These were run in the same direction on the same section of track under weather conditions as nearly uniform as possible. Each car was equipped with a recording device for measuring the several quantities sought. The practical result of these tests was the modification of certain types of braking apparatus on the cars.

The second paper of the evening, entitled "Railroad Car Braking," by Mr. R. A. Parke, of the Westinghouse Air Brake Company, was then read. The paper gives a sketch of the practical development of brakes in railway service and an analysis of the results of investigations of brake-shoe friction, with particular reference to the Westinghouse-Galton tests conducted in 1878 by Mr. George Westinghouse and Captain Douglas Galton upon the London, Brighton & South Coast Railway, England. A definition of the requirements and limitations of brake efficiency in practice is then given, and the loss of braking efficiency due to disturbance of the normal rail pressures by brake retardation is considered, with a description of the means of compensating for it. The peculiar characteristics of the magnetic brake are also described. This paper will be reproduced in full in the ELECTRICAL REVIEW.

The discussion of these papers was very interesting, although few new points were brought out. President Scott called attention to the revelations which a scientific and mathematical study of an apparently simple problem had brought to light. Mr. Parke's paper was really a beautiful mechanical story of the problems presented in braking and the means of overcoming difficulties.

Mr. H. G. Stott congratulated both the author and the Institute on the excellent paper which Mr. Parke had presented. The subject had been covered so fully that there seemed to be little to be added. He could give but little information from his own experience, as his work was concerned with the positive side of the problem, namely, that of the power-house.

Mr. C. O. Mailloux expressed his high appreciation of the paper presented. He thought that ten years from now this would still be a standard work. In his opinion this was not a proper time to discusss a paper of this character, as the matter therein contained could not be thoroughly digested in less than a week's study. The problem of braking, although apparently simple, was very complicated, as a number of independent variables were involved, and for this reason it has been impossible to give a typical braking curve. He had devoted a good deal of time to analyzing braking tests and had not been able to secure a typical curve. Mr. Keiley's paper was exceedingly interesting, as it was a direct attempt to obtain braking data. Although it might be impossible to get a typical braking curve, it was desirable to get an idea of this, so that any accurate data were exceedingly welcome.

Mr. C. Townley gave a brief description of some braking tests which had been conducted in Boston a year ago. He pointed out a number of desirable features of the new method of suspending the brake shoes as advocated by Mr. Parke. In this system the shoes are placed between the wheels of each truck and not, as is now generally the case, on the outside. With the brake shoes between the wheels dirt would, in his opinion, be thrown away from the electrical equipment.

Mr. W. C. Gotshall asked information concerning the relative efficiency of quick-acting air-brakes and magnetic brakes, the relative cost of stopping the train, of maintenance, and the effects of the new method of suspension upon the equipment and the wheels. He had heard that with the shoes between the wheels more trouble had been experienced at Boston than with the previous arrangement. Referring to the cost of stopping, tests had shown that this was twelve per cent less with power brakes than with hand brakes, as in the latter case the motormen were apt to leave the brake partially on.

Mr. Parke, replying to the above, stated that as yet no reliable data for magnetic braking were available, which could be compared with the high-speed brake. In the former case stops ought to be much better, as in addition to the variable pressure applied to the wheels there was the added retardation due to the magnetic brake itself upon the track. The magnetic brake had not been in service long enough to determine the cost of maintenance. In regard to the method of sus-

pending the brake shoes inside, the steam roads had found this to give much better results. No ill effects on the equipment had been noticed in this service, although the increased pressure upon the wheels would cause a greater wear. This was a matter of small import. It is well known that the wear of the wheels, due to the track, was more serious, and it had been found more economical to use the brake shoes for truing the wheels than to do this in the shop. The electric brake required but little attention, although there was of course an additional part to be taken care of. To the question whether this method of suspension had been covered by a patent, he said it was not patentable

Mr. E. E. Ries asked whether any increase of braking effect had been detected, due to the magnetization of the rail. Mr. Parke replied that no effect had been noticed, but no attempt had been made to determine this.

Mr. W. N. Smith gave a brief account of some braking tests he had conducted, in which the back torque of the motors was used to stop the car. He found that in many cases the rear wheel of the truck was actually driven backward, demonstrating the decreased pressure on the rail at this point.

Professor W. S. Franklin called attention to the limitations of quantitative mathematics in engineering. He used as an illustration the problem of determining the flow of water in a pipe. He thought that it was an impossibility to express in exact mathematical terms either the loss of head or the flow of water, because the system was not in equilibrium, as conditions varied continually throughout the whole length of the pipe. While it was possible to obtain a mean value for the flow which could be used, no value could be given for the instantaneous pressure or flow at any point in the pipe. In his opinion the braking problem was very similar, and it was for this reason that it had defied mathematical analysis.

Mr. H. H. Westinghouse called attention to another indeterminate quantity in all such experiments, namely, that of the man who works the brake. It is impossible to separate this factor from the others. No great amount of data on a magnetic brake was at hand, because it was desirable first to submit the brake to a practical test before making experiments.

Professor William Esty, in response to the president's request, gave a brief account of the enthusiastic manner in which the local section at Lehigh University had been organized and its work carried out. He had found this to be a great help in his work, as well as a source of inspiration for the students.

Others who took part in the discussion were O. S. Liford, H. A. Foster and W. J. Hammer.

RAILROAD CAR BRAKING.

BY R. A. PARKE.

The braking problem is as old as railroading, and, in the early conception of it, the problem appeared a simple one. Practical railroading had no sooner accomplished the motion of trains than the necessity for stopping them appeared, and it was early perceived that the "adhesion," as it was usually called, or the frictional resistance to sliding of the wheels upon the rails, through which the wheels continue to rotate in spite of considerable resistance, is the most available retarding force. The application of a brake to the wheel to excite the retarding influence of the rail friction had naturally suggested itself, and when, in addition, the simple mechanism was provided for manually applying the brake to the wheel with sufficient force, in an emergency, to cause the wheel to slide upon the rail, the braking problem appeared to have been satisfactorily solved. Under the operating conditions of railroading then existing, the application by hand of brakes to a portion of the wheels of a train was ordinarily sufficient for all practical purposes, and when, in an emergency, the brake resistance so acquired was sufficient to overcome the rail friction and cause the wheels to slide upon the rails, it was quite generally conceded that the most that could be expected had been accomplished, and a disaster not averted by such means was accepted as one of the unfortunate but unavoidable contingencies of railroading. This early method of controlling the speed of trains has since been modified only by the substitution of mechanical for physical power in the application of the brakes, which has been extended to all the wheels, and by so restricting the pressure of the brake shoes that the wheels shall not be caused to slide upon the rails; but the diversified and intricate character of the influences now recognized as constituent elements in the efficiency of the power brake, have involved the subject in much complication.

The advantage of the use of power, under the control of the engineer, for promptly applying brakes upon all the wheels of a train, early became recognized, and the special advantages of compressed air for the transmission of the power throughout trains of considerable length, established the air-brake in a pre-eminent position. At first the compressed air was stored in a reservoir upon the locomotive and, by means of a line of iron pipe, extending throughout the length of the train, with flexible hose and couplings between vehicles and an operating valve upon the locomotive, it was conducted to the brake cylinder upon each car, by which the brakes were applied to the wheels through the intervention of suitable rods and levers. The time required to convey the necessary volume of compressed air from the storage reservoir upon the locomotive to all the brake cylinders of even a comparatively short train, and the total disability resulting from rupture at any point of the air conduit, caused this form of air-brake to be supplanted by the automatic air-brake, in which an auxiliary storage reservoir, of sufficient capacity to operate a single-brake cylinder, was added upon each car. Through the operation of a triple-valve device, which connects the train pipe or air conduit, the auxiliary reservoir and the brake cylinder upon each car, admission of compressed air into the train-pipe causes each auxiliary reservoir to become charged to operate the brakes, and discharge of air from the train pipe, from any cause, causes communication with the auxiliary reservoir to be transferred from the train pipe to the brake cylinder, whereby a corresponding quantity of compressed air is discharged from the auxiliary reservoir into the brake cylinder. By defining the reduction of pressure of air in the train pipe, the pressure of the brake shoes upon the wheels may be graduated to any desired degree within the limit established by the ultimate equalization of air pressure in the auxiliary reservoir and the brake cylinder, and accidental rupture of the train pipe instantly operates to stop the train and to prevent further progress without effective repair. In any case, restoration of the air pressure in the train pipe actuates the triple valve to reestablish access to the auxiliary reservoir, whereby it is recharged with air pressure, and to transfer communication with the brake cylinder from the auxiliary reservoir to the atmosphere through which the brakes are released.

When the automatic air-brake became employed upon freight trains, it was discovered that, in making a quick stop by venting the train pipe at the locomotive, the interval of time required to cause an operative reduction of the air pressure in

the train pipe at the rear end of the train was so considerable that effective application of the brakes upon the rear cars was delayed until sufficient retardation of the forward portion of the train had become effected to cause a collision with the rear cars which damaged and often disabled the cars and did violence to the lading. To remove this obstacle, the automatic air-brake became superseded by the quick-action automatic air-brake, in which, when a quick stop is desired, each triple valve opens a vent in the train pipe in addition to the vent upon the locomotive. By this means an operative reduction of the air pressure progresses throughout the train pipe, of the longest trains, with nearly the velocity of sound, and damage from the serial character of the application of brakes by compressed air becomes practically eliminated. Incidentally, also, in the local venting of the train pipe air at each succeeding triple valve, the utilization of this source of power, formerly wasted at the engineer's operating valve, was accomplished by conducting the vented air into the adjacent empty brake cylinder, before it receives the ordinary supply provided by the auxiliary reservoir. Thereby, the ultimate air pressure in the brake cylinder is augumented about twenty per cent, and the character of the application of the brakes in disaster-threatening emergencies is further distinguished from that in ordinary service, where neither the violence nor the power of the emergency application is desirable or even tolerable.

While the character of the development of the compressed air-brake has thus been chiefly dictated by conditions rendered conspicuous by increased length of trains, and would hardly have been suggested under the conditions to which electric railroad operation appears best adapted, the high operative efficiency and other advantages thereby acquired are participated in by short as well as long trains, and are therefore of interest in dealing with the question of braking in electric service. Where even only two cars are operated together as a train, the automatic feature of the air-brake is still essential, in precisely the same way, if not in the same degree, as in longer trains, and, except where cars are always operated singly, the same is true of the increased efficiency secured through the quick-action feature of the automatic brake.

The first systematic or comprehensive investigation of the effect of the brakes upon the wheels of moving vehicles was that of an elaborate series of experiments, conducted upon the London, Brighton & South Coast Railway, in 1878, with apparatus constructed and operated by George Westinghouse, under the supervision of Captain Douglas Galton, representing the Institution of Mechanical Engineers, and which are now commonly known as the "Westinghouse-Galton" brake tests. The ingenuity and perfection of the apparatus, and the scientific and unbiased character of the experiments, establish this investigation upon a high scientific plane and give its results an authoritative standing which has never been impaired or supplanted by subsequent investigations. Had the range of these experiments been extended but a little farther, the entire subject would have been elucidated. In fact, while later experiments have demonstrated the importance of additional information, that information has not yet been definitely supplied, and the Westinghouse-Galton investigation still stands as the only reliable source of definite knowledge concerning the important characteristics of brake-shoe friction.

More recent investigations have been conducted upon a machine devised for experimenting upon the friction of brake shoes, but their purpose has been to determine the relative commercial values of brake shoes of different materials, rather than to supplement the information furnished by the Westinghouse-Galton tests. While such investigations have doubtless been useful in indicating the relative advantage of different materials for brake shoes, and have, perhaps, satisfactorily determined, within the limits, the degree of efficiency which may properly be required of brake shoes, they have added to previous knowledge of brake-shoe friction only in suggesting certain characteristics without furnishing adequate data to extend our knowledge of the action of brakes in stopping a train.

The Westinghouse-Galton experiments were conducted in a moving four-wheeled car, provided with the necessary recording apparatus, the wheels being steel tired and the brake shoes of cast iron, and the results of the experiments may be summarized as follows: The coefficient of brake-shoe friction decreases with increased speeds and, at constant speed, it decreases with the increase of the time that the surfaces are in contact. The coefficient of friction does not appear to increase with increased pressure per square inch. When the wheels roll without sliding upon the rails, the rail friction (or adhesion) is unaffected by the speed, but declines greatly with sliding of the wheels, when it varies inversely with the speed, corresponding with the brake-shoe friction, but is much inferior thereto. The rail friction is very materially affected by the condition of the rail, being greatest when the rail is perfectly dry or very wet (as when washed by a hard rain) and least when the rail is quite moist; but by the use of sand upon the rails the effect of moisture is practically eliminated.

The actual variation of the brake-shoe friction with increased speeds is very regular, beginning with the friction of rest (static friction) and declining, very rapidly at first, but with continually decreasing rapidity, up to the highest speeds of the experiments. The undoubted fact that the friction can not vanish for any finite speed, considered in conjunction with the peculiar character of the decline, suggested to the writer that the results of the experiments might be properly represented by a portion of an equilateral hyperbola, and upon applying the theory of probability to the mean results, the coefficient of friction is found to be represented by the equation

$$f = \frac{0.326}{1 + 0.03532\,V}$$

in which V represents the speed in miles per hour. The following table shows both the computed coefficient of friction from this formula and the means of the observations up to a speed of 100 miles an hour:

Speed V.	Coefficient of Friction, f.		Speed V.	Coefficient of Friction, f.	
	Computed.	Observed.		Computed.	Observed.
....	....	....	40	.135	.140
0	.326	.330	45	.126	.127
5	.277	.273	50	.118	.116
10	.241	.242	55	.111	.111
15	.213	.223	60	.105	.074
20	.191	.192	65	.099	....
25	.173	.166	70	.094	....
30	.158	.165	80	.085	....
35	.146	.142	90	.078	....
....	....	....	100	.072	....

It is worthy of note that the mean observed result for a speed of sixty miles per hour differs materially from the result of a law that applies with remarkable fidelity to the observed results at other speeds. This is perhaps attributable to two causes—first, while each of the other results (except for the lowest three speeds) is the mean of from fifty-four to ninety experiments, that for sixty miles represents but twelve experiments—much the smallest number at any speed—of which the maximum observed result was 0.123 and the minimum was 0.058. The other probable cause is that, it having been discovered that the coefficient of friction is less at high speeds, the pressure

was much increased at the very high speeds to compensate, and it is now known that the coefficient of friction is an inverse function of the pressure. The mean result at sixty miles an hour does not, therefore, appear to be fairly comparable with those at other speeds, and it has been ignored in determining the constants in the above formula.

In the tabulated results of these experiments, Captain Galton gives the maximum and minimum, as well as the mean value of the coefficient of friction observed for each speed. It is observable that the maximum values very well follow a similar law to that above given for the means, while the minimum values are too irregular to suggest more than a general inclination to decline as the speed is increased. As the maximum values correspond more nearly with the results of more recent experiments, the writer has also formulated them. The most probable law is represented by the equation.

$$f = \frac{0.382}{1 + 0.02933\,V}$$

and the calculated and observed values are given in the following table:

Speed V.	Coefficient of Friction, f.		Speed V.	Coefficient of Friction, f.	
	Calculated.	Observed.		Calculated.	Observed.
0	.382	....	45	.165	.179
5	.333	.340	50	.155	.153
10	.295	.281	55	.146	.136
15	.265	.280	60	.138	.123
20	.241	.240	65	.131	....
25	.220	.205	70	.125	....
30	.203	.196	80	.114	....
35	.188	.197	90	.106	....
40	.176	.194	100	.097	....

The decrease of the coefficient of brake-shoe friction from continued contact apparently follows the same character of law as does that from increase of speed—that is, the fall is rapid at first, but the rate of fall quickly begins to decline. It was assumed by Captain Galton that the decline of the friction is as the increase of the time of contact, but a careful analysis of the results shows that it is a function of the product of the speed and the time, or of the distance through which the shoe rubs upon the wheel. It is very unfortunate that the observed effect of continued rubbing does not extend over sufficient time to permit reliable formulation. The more recent experiments appear to show that, at the same speed, the friction becomes constant after a time, but it is probable that the coefficient of friction continues to yield to the influence of continued rubbing throughout stops from the highest speeds yet attained in practice. In formulating the incomplete data of Captain Galton, therefore, the purpose is merely to present as comprehensive a view as possible of the complexity of the subject, and the results must not be accepted as trustworthy for practical use. Accepting the conclusion drawn from the later experiments, that the coefficient of friction remains stationary after some definite period of continued rubbing at constant speed, the question is still open as to whether the stationary point is the same for all speeds or is simply a function of the initial coefficient of friction, corresponding to the speed and brake-shoe pressure. While there is no definite information upon this point, beyond the limited observation of the Westinghouse-Galton experiments, that so far as it goes points to the latter view, and all our information suggests the probability that the ultimate level is different for each different initial coefficient of friction. The corresponding equilateral hyperbola is therefore represented by an equation of the form.

$$f_1 = \frac{1 + h\,s}{1 + c\,s}$$

where f is, as hitherto, the initial coefficient of friction, corresponding to the speed pressure, s is the distance, in feet through which the surface of the wheel has traveled in frictional contact with the brake shoe, and h and c are constants. Applying the theory of the least squares to the observations of Captain Galton (except those at a speed of sixty miles an hour, which are omitted for reasons already given), the values found for h and c cause the above expression to become

$$f_1 = \frac{1 + 0.000472\,s}{1 + 0.002390\,s} f$$

Thus the coefficient of friction, f, for a given speed, as indicated in the tables already submitted, becomes reduced, after the brakes have been applied through a distance of 50 feet, to 0.914 f; after 100 feet, to 0.845 f; after 200 feet, to 0.740 f; after 300 feet, to 0.665 f; after 500 feet, to 0.563 f; after 1,000 feet, to 4.34 f; after 2,000 feet, to 0.336 f, and the ultimate level, which is not yet reached after two miles, is 472/2390 f, or about 0.2 f. The later experiments upon the efficiency of brake shoes included some temperature tests, the results of which indicate that, under the conditions of those experiments, the stationary level is reached after from 2,000 to 3,000 feet, and there is good reason to believe that it is much higher than 0.2 f. Of the observations employed in determining the constants in the above expression, none was for a greater distance than 814 feet. The larger number were for short distances, which thus gave undue weight to the rapidly falling portion of the curve, and, in the absence of more extended observation, no practically useful mathematical application of this characteristic of brake-shoe friction can be realized. As it exerts a very important and effective influence upon the friction and the rate of retardation during every stop, the impossibility at present of determining the rate of retardation under varying conditions is obvious.

(To be continued.)

"The How and Why of Electricity."

The manuscript for this book was completed but a short time before the death of its author. Charles Tripler Child had received numerous requests for a book treating on the general theme of electrical phenomena and the operation of familiar electrical apparatus. It was in response to such appeals that he set to work on the manuscript which bears the above title. He was one who possessed a rare faculty of explaining in a most lucid manner those things which, burdened with technical language, become hard for the unschooled reader to comprehend. "The How and Why of Electricity" is not a hand-book by any means; it is a charming little story told in a vein which the layman can readily appreciate, and at the same time it is a work from which the professional man can gain a great deal of information. The book is divided into twenty-three chapters and is well illustrated with simple line drawings which avoid all complexity and are easily comprehended. The volume contains 128 pages and is printed on soft antique paper, finished with deckled edges. The binding is of dull green cloth, the illuminated title being worked in silver leaf. The size is five and one-quarter by seven and three-quarters inches.

No effort has been spared to make the book as attractive as it is valuable, and the sentiment which the author inspired in all those with whom he came in contact will, the publishers hope, be perpetuated by the little volume which he left behind him.

The book sells for $1, prepaid, and is published by the Electrical Review Publishing Company, New York city.

Index for the Volume—July to December, 1902.

The index to the volume of the ELECTRICAL REVIEW for the twenty-six numbers, running from July 5 to December 27, inclusive, is mailed with every copy of this week's issue. This should be preserved as a ready reference, and every subscriber should look out for a copy of this index as extra copies can not be secured.

MEASURED SERVICE.*

GEORGE N. BANDY, DES MOINES, IOWA.

Of all public utilities, gas appears to have been the only one charged for from the beginning according to quantity consumed. Until recently it was a common practice, and is yet the custom in many places for water companies to charge according to the number of rooms in a house or number of front feet in the lot; now the modern practice is to charge a certain rate per 1,000 gallons. It was formerly the rule for electric light companies to charge for current according to the number of lamps connected, but now an up-to-date company charges according to watt-hours or the actual quantity used.

The pioneers in the telephone field—who, by the way, were the various Bell licensees—not having at the time the telephone was first brought into commercial use apparatus by which the number of calls could be accurately recorded, adopted the expedient of charging for the service an arbitrary rate per month, having a higher rate for business than for residence telephones. This practice still largely obtains among the independent companies, but the Bell licensees are breaking away from that custom as rapidly as possible; especially is this true in the larger cities.

There are several reasons for making the change; it yields a larger income per telephone, increases their list of subscribers and, last but not least, rids their patrons of that intolerable nuisance known as a dead-head who uses your service in many cases more than a regular subscriber without paying therefor, and 99 times out of 100 not only fails to show his appreciation of the convenience by thanking the company or subscriber, but is loudest in his denunciation of what he is pleased to call "the rotten service" the company is furnishing.

Many of the independent companies have profited by the mistakes of opposition companies, but I am sorry that there is a large number who have not made the most of their opportunities. We are now able to purchase telephone apparatus that so far as its signaling and talking qualities are concerned, seems well nigh perfect, and is certainly equal if not superior to anything used by the Bell licensees. This being true, why should we hesitate to adopt "measured service?" It is certainly fair to both the patron and the company, and I see no good reason why the change should not be made.

For a number of years the word "independent" has had a wonderful influence upon the public, and during that time they have given us their confidence, goodwill and money, and are now not only requesting, but in many cases are demanding, that they be furnished not only with first-class but modern service, embodying the latest ideas. It is therefore plainly a question of the survival of the fittest, and if we expect to remain in this business it is only too evident that we must be continually on the alert for, and introduce the latest and most approved type of apparatus and inaugurate such changes in the handling of and charges for, telephone service as seems appropriate and satisfactory to the public.

I believe that the majority of our subscribers would welcome a change from the present flat-rate system to the "pay for what you get" principle. It may be, however, that the apparatus for recording the number of calls is not sufficiently perfected to warrant our making this change, but as necessity is the mother of invention, I confidently believe that if it is shown that the apparatus now available for this purpose is not efficient, that some one will soon place on the market an instrument that will meet our requirements.

In charging for telephone service on the meter basis, it may be necessary, of course, to have the subscriber guarantee a certain number of calls per month; for instance, a residence telephone might guarantee twenty-five calls at four cents each per month, all in excess of that number to be charged for at three cents per call. Business telephones $2 per month for forty calls; all in excess of that number three cents per call. The guarantee as to minimum number of calls per month to be varied to suit local conditions. No calls to be recorded unless the number or party called is obtained. All incoming calls free.

These are merely brief suggestions for your reflection. There are various ways offered by others for accomplishing a similar purpose. An idea laid down by a prominent telephone man as long ago as 1895 has been adopted for practice by a number of telephone companies. It has later become the rule in some foreign countries. It is to first charge a flat rate, covering a reasonable amount for the subscriber's station maintenance, then a charge additional for the service, or a switching rate of so much per call, varying from two to six cents for exchanges.

I understand that here in Chicago the new system is based upon a similar idea, but the method of applying the rates differs. The Chicago company may fairly be called the largest prospective exchange telephone company in the world. Recently, after the most elaborate and searching preparations, it concluded upon what it calls its new policy, of meeting the independent and the demands of its patrons for lower rates. This so-called new policy, I am told, consists in a determination to establish message service or its equivalent, almost, if not entirely.

The plan is to require a guarantee per month per telephone, and then an additional five or ten cents per call on the main exchanges. The company operates a large number of exchanges outside of the main part of the city. These exchanges are sometimes called suburban exchanges. For instance, if you are a telephone subscriber in Englewood, in the southern part of this city, or Rogers Park, in the northern part, you must pay a flat rate (said to cover a so-called local service) of about $30 to $60 per annum, then on each call for the main exchanges you pay ten cents more.

I refer to the Chicago telephone service methods because that company is known to many as being progressive, and we are better acquainted with conditions here than in other places where this message service is being adopted. I do not go into details, because you may readily learn more by enquiry, but I am not averse to adopting any new improvements, even if the Bell first shows the public desire them.

This subject must have an important bearing on our future; we ought now to begin to learn all about it. It is possible that some here have had actual experience with it, and, no doubt, many others can give us good ideas or information regarding it. I have thought it best to simply call attention to some of its points rather than give specific data at this time.

*A paper read before the Interstate Independent Telephone Association, Chicago, December 10, 1902.

State Electrical Laboratory.

An important meeting of the New York State Electrical Laboratory Commission was held at Schenectady, N. Y., on December 9. State Engineer Bond, Harold W. Buck, of Niagara Falls; C. P. Steinmetz, of Schenectady, and State Architect Hines were present. Plans already submitted to the commission were approved, and Messrs. Buck and Steinmetz reported on the amount of space needed for the apparatus which with the proposed buildings will cost between $250,000 and $300,000. The buildings will cost about $100,000. The commission decided to make a preliminary draft of its report to the legislature.

TOLL RATES.*

BY H. H. ROBINSON.

Long-distance, or more properly speaking, interurban telephone service was established in the early eighties by various licensees of the American Bell Telephone Company. The rates established for service over these lines were not based upon the cost of producing it, from any information I have been able to secure, but rather upon the telegraph rates which at that time represented the only competition. These rates varied in different parts of the country from less than one-half to one and one-half cents per mile, and the time limit varied from five to ten minutes, although overtime was seldom charged. It was not until the incorporation, by the Bell interest, of the American Telephone and Telegraph Company that any considerable time and thought were given to this most important subject.

In the early nineties a rate convention was called by the American Bell Telephone Company, and delegates attended from many of the licensee companies. As a result of this convention, and the vast amount of preliminary work which preceded it, a standard basis of computing rates was adopted, which not only fixed the rate per mile and established the time limit, but also established the method of computing overtime, measuring mileage and computing rates so as to avoid the odd cent. I will state briefly the main features of this schedule. All rates were to be based on a charge of one-fifth of one per cent per mile per minute. The time limit adopted by the American Telephone and Telegraph Company was five minutes, and the limit adopted by other licensee companies was three minutes. In computing the mileage it was decided that the air-line distance would work a great hardship upon the companies because of the few routes which then existed and the roundabout way which nearly every message had to be carried. It was also decided that pole mileage would work a hardship on the patrons who were not responsible, and should not be required to pay for the failure of the telephone company to provide direct facilities. Therefore, as a compromise, it was decided to use the nearest railroad mileage. Overtime was to be computed at one-third or one-fifth of the initial rate, according to whether a three or five-minute schedule was used, and in cases where this method of computation produced an uneven number of cents, the minute rate was fixed at the nearest nickel. In order to avoid the large number of uneven rates, which would exist if rates were based on the exact mileage, the following table was prepared:

	Cents
5 miles or under	10
6 to 15 miles	15
16 to 24 miles	20
25 to 35 miles	25
36 to 45 miles	30
46 to 50 miles	35
51 to 60 miles	40
61 to 75 miles	45
76 to 85 miles	50
86 to 90 miles	55
91 to 112 miles	60

The only matter of importance not touched on by the rate convention was the subject of special rates for night and Sunday service, and it was not until 1896 that the licensee companies adopted the half rate night schedule, and it was not until 1899 that the American Telephone and Telegraph Company followed suit.

In the latter part of 1899, or the early part of 1900, the American Telephone and Telegraph Company changed from a five-minute to a three-minute basis for all rates on either side of Buffalo and Pittsburg. Rates going from one side of this imaginary boundary line to the other side are still based on a five-minute period.

In certain parts of the United States, most notably in California, a period of ten seconds was introduced and has been quite successful owing to the peculiar geography of that part of the country and the careful way in which the subscribers were educated. One-minute rates have been introduced in various other parts of the country, but have not been successful, either from a financial or operating standpoint. The principal reasons for the failure of this short period to succeed were, first, because of the inability of the companies to furnish facilities in the shape of direct circuits, and second, because of the magnitude of the task of educating so large a number of subscribers separated into small communities, each having several centres of commercial influence.

To make this point more clear, I will say that, from the very careful study I have made of the subject, the fractional minute rate, or even the one-minute rate, will never be practicable until toll-line companies are able to furnish a sufficient number of direct circuits between points where it is desirable to establish such rates to promptly handle the business, and also to furnish each direct circuit with an operator at either end having no other business to handle. Furthermore, toll-line patrons will have to be educated to the point of either transcribing or memorizing their proposed conversation before the connection is established.

I will now try to reply to the enquiry, which, without doubt, is uppermost in your minds: "How did the rate conference arrive at its minute-message mile rate of one-fifth of one cent per mile per minute?" When I first decided to prepare this paper I made a strong effort to secure from certain officials of the American Telephone and Telegraph Company the minutes of the first rate conference, as I preferred to quote from them verbatim. I was, however, unable to secure this rather important document, and I must therefore be content to briefly describe the process and line of thought by which the initial rate basis, which is now almost universally used, was devised. Let us create for our purpose a toll-line property, consisting of thirty miles of pole line, ten miles of which consists of the very best construction, forty thirty-foot seven-inch top poles to the mile, with an ultimate capacity of fifty wires and a present capacity of twenty; we will suppose that the second ten miles represents the average construction of thirty twenty-five-foot six and one-half-inch top poles to the mile, with an ultimate capacity of twenty wires and a present capacity of ten wires; the third ten miles to consist of a twenty-five-foot bracket line, built upon the cheapest possible specifications, and used presumably as a feeder to reach some small town. We wish to discover what rate we can safely make per minute-message mile and show a profit on our investment. Our first section will cost us approximately $950 per mile or $9,500; our second section will cost approximately $500 per mile or a total of $5,000; our bracket line $150 per mile or $1,500, giving us a total investment for this imaginary property of $16,000. Figuring interest at five per cent and depreciation at five per cent, our fixed charges will be $1,600. Operation and maintenance, including taxes and general expense, and extraordinary maintenance, may be safely figured at ten per cent more. We must therefore earn $3,200 per annum on the $16,000 investment before we can show any profit for stock. We can not, as in an exchange proposition, base our prospective earnings upon our number of subscribers and our average earning per subscriber, for toll business is strictly a measured service, and no matter how good our facilities we can not handle business until it is offered.

* A paper read before the Interstate Independent Telephone Association at Chicago, December 10, 1902.

The telephone day averages from four to seven hours' pay per day, according to locality, and from several hundred peg counts which I have examined, the circuit load varies from one-half message per circuit mile per day to three messages per circuit mile per day. As we wish to be conservative, we must adopt the minimum figures if we would have a safe rate.

Now this little imaginary system of ours contains 310 circuit miles. On the basis of one-half a message per circuit mile per day, we would handle 155 three-minute messages per day per circuit mile, and if these messages averaged ten miles, as they probably would, we would handle 1,550 message miles per day. To reduce this to minute-message miles we multiply by 3, which gives us 4,650 minute-message miles per day, or 1,674,000 minute-message miles per year. Now we have seen that we must earn at least $3,200 per year in order to cover our interest, depreciation, operation and maintenance, so by dividing $3,200 by 1,674,000 minute-message miles we find that we must charge and receive 0.0019 of one cent per minute-message mile. The Bell rate conference decided upon 0.002 of one cent per minute-message mile, and the result of our little computation shows that by charging that rate we will still have 0.0001 of one cent per minute-message mile to spare on the basis of the most conservative figures we can possibly use. Please bear in mind that aside from the estimated circuit load the figures which I have used are selected arbitrarily and mean nothing except to demonstrate the line of thought.

This basis of computing rates is being used to-day by nearly all of the larger independent toll-line companies and is found to be profitable. As to the future, it is difficult to anticipate the readjustments which are bound to come as labor and material increase in cost, but, as a personal opinion, which you can accept for what it is worth. I would say that I believe that improvements in operating and advances in the art will more than offset the increases in construction and maintenance. For the present, we stand in urgent need of uniformity, for there is no one branch of the business where the lack of it is so sadly felt as in this great question of toll rates. In nearly every other part of the business details of operation have an effect upon the local situation only, but their effects on toll-line service are as far-reaching as the country itself.

SUGGESTED METHODS FOR IMPROVING LONG-DISTANCE TELEPHONY.*

CHARLES E. HULL, ILLINOIS.

Improvement is the slogan of this age. Especially is this true of telephony. The time was when almost any kind of an instrument or line would suit the otherwise progressive citizen. Any sort of communication by spoken words was progress, and the poorest and often interrupted service was readily forgiven. Rapid strides are being made in improvement of instruments and the public is fully aware of it. We can but expect that they demand better, if not perfect, service. There are many reasons why independent telephone service, ever improving, has not reached the highest standard of excellence. Nine-tenths in point of number of the independent telephone exchanges have been built with the primary object of supplying local service and without any thought on the part of the promoters of any necessity arising whereby they would be called upon to extend their lines and procure for their subscribers and customers any communication beyond that afforded by their limited faculties. At the beginning of this enterprise the community served and the company furnishing the service were agreed, and a unit as to the objects and uses of a local telephone exchange. But soon the people of a neighboring town or perhaps country seat, in their casual business with their fellows, perceive the advantages gained by their friends or perhaps rivals across the prairie, and forthwith over night plans were laid for the construction and operation of the Blankville independent telephone exchange. Soon it was discovered that, although striving to outdo each other, both commercially and socially, these adjacent communities must have opportunity to reach each other quickly. According to the advertisements in some public places that we may read while we impatiently wait for the answer to our call—the mail is quick, the telegraph is quicker, but the telephone is quickest. For this reason a connecting telephone line is proposed. It is hurriedly built. I say hurriedly for the reason that additional facilities for communication between existing plants invariably bring a host of clamoring people who want their telephones installed instantly. Once the telephone habit has taken hold of a community there is no way to check it except by bad equipment, poor service and gross inattention to the wants of the people.

* Paper read before the Interstate Independent Telephone Association, Chicago, December 9, 10 and 11, 1902.

Emulating the example of the prosperous farmer in his endeavor to buy all the land that joins him, managers and patrons join in the effort to reach surrounding communities. The undertaking is laudable and popular. Lines are built that answer for the time, and the interested communities are happy and contented. The work goes merrily on. The circle widens and all goes well until its outward boundaries touch and overlap a similar telephone system.

The two systems are joined at perhaps some out-of-the-way place without any thought of the consequences, and announcement is made that a system is ready for "through" business with the other. Satisfied subscribers vanish. There seems to be no call for the service now asked for prior to that time. But now that it is within reach it must be furnished. Any up-to-date manager can read the handwriting on the wall. He must not be weighed in the scales and found wanting. It is useless for him to explain that the fault is at the other end of the line. Whatever it is, it must be remedied. It matters not if the remedy involves the expenditure of more than his plant can comfortably afford; it must be done. The high-sounding title and the far-reaching import of the subject under such a title are calculated to mislead. The manifest inadequacy of sufficient suitable means of telephonic communication between independent exchanges within our association prompts the subject. The primary object of the suggestions offered will be looking more to the ways and means of securing the needed better "local" long-distance communication rather than purely "long-distance" telephony. There is but one solution to the latter problem. One company or a system of connecting companies must furnish such service to the independent field. Until the independent movement obtains sufficient foothold in the larger commercial centres, provision must be made, more or less local in its nature, for carrying "local" long-distance messages, and especially such cases as I mentioned at the outset. For instance, in my own state of Illinois, there is hardly a line out of the chain of independent exchanges from Egypt to the Wisconsin line, or from the banks of the Wabash to the Mississippi. We can each of us hold communication with our neighbor on either hand, and perhaps with our neighbor's neighbor, but beyond that we must resort to the unsatisfactory practice of repeating the message. What shall be done? My many letters of

enquiry directed to many exchange managers brought no satisfactory solution or answer. Strong companies are occupying the larger inland cities of the states. How are the smaller inland cities and towns to reach them satisfactorily? The composite ideas to my enquiries seem to be embraced in the following three propositions, namely:

First—That the present system of lines connecting individual exchanges be continued and improved.

Second—That companies be formed along a given route to build metallic standard construction lines to operate in conjunction with the already established exchanges. The stock in the company to be subscribed by connecting systems.

Third—That encouragement be given to the formation of entirely independent long-distance companies which will connect on favorable terms with individual exchanges.

I present these three ideas to the convention for discussion. The general sentiment seems to be that whichever of these ideas seems to be best, or a combination of the three, will be readily adopted by all concerned, other than building standard construction. The most practical suggestion for improving present conditions is that new lines be run under present conditions on the same poles as now with no telephones on, and that these lines terminate in open jacks on the respective switchboards of the different companies or stations. All calling should be done over present lines. When a so-called through message is to pass several switchboards, operators are to be notified to connect the new line by means of these open jacks. This would be at best a makeshift, but certainly would be a vast improvement on present conditions.

The second plan presents some complications which will be hard to overcome. The theory is a good one. It seems to me that practice will demonstrate that it will be a difficult matter to adjust the different ideas and conditions which will be brought into such an organization. It would seem strange if any two stockholders in such a company would come under similar circumstances. It is not my province to discuss these matters, but I hope they will be brought out in the discussion which follows.

The practical system for the advancement of the independent telephone movement, it seems to me, would be a combination of the three ideas above suggested.

There is a great deal of purely local telephoning that is offered subscribers so cheaply that no long-distance company could undertake it. Under this head comes free county service. Lines of the long-distance company could be run to the main office of such a company with the understanding that all incoming lines from other stations be of standard construction. Better still, the long-distance lines should touch each exchange. Through business should be given the long-distance company direct, and local business remains with the home company.

Conflicting interests are so diversified and individual wants so varied that the best thought of the best men among us will be necessary to bring order out of chaos. The betterment of existing facilities for the transmission of messages will not accomplish all of the results desired. We must adopt some definite plan of action and have better facilities for the settlement of our accounts and (I am sorry to relate) our differences, together with a board whose business it is to adjust all these things. These last-mentioned matters, of course, do not concern the general public, but they are of vital interest to us. We should be the people who are endeavoring to lead the movement into a sound business policy. By so doing, we will gain the confidence of the financial world and thereby be enabled to make all the necessary improvements to our plants so that we can give to the public the best service known in the science of telephony.

National Electric Light Association.

Since the passing of the rule at the convention in Cincinnati increasing the initiation fee and membership dues in the National Electric Light Association, there has been a most important addition to the roll. The list of names has been doubled since the convention in June, there having been added 180 new names to the register. The most recent applications for membership are as follows:

Franklin Falls, N. H.—Franklin Light and Power Co.

Lambertville, N. J.—Hunterdon Electric Co.

San Francisco, Cal.—The Standard Electric Company of California.

Victor, Col.—Pikes Peak Power Co.

Phœnix, Ariz.—Phœnix Light and Fuel Co.

San Leandro, Cal.—Suburban Electric Light Co.

Lewiston, Ida.—Lewiston Water and Power Co.

Hillsboro, Ill.—Hillsboro Electric Light and Power Co.

Saginaw, Mich.—Bartlett Illuminating Co.

Ann Arbor, Mich.—Washtenau Light and Power Co.

Marshfield, Ore.—Marshfield Lighting Co.

Fort Smith, Ark.—Fort Smith & Van Buren Light and Transit Co.

Oneida, N. Y.—Madison County Gas and Electric Co.

Idaho Springs, Col.—The Cascade Electric Co.

Idaho Springs, Col.—The Consolidated Gem Mines Co., electrical department.

Southampton, N. Y.—The Southampton Electric Light Co.

Paris, Tex.—Paris Light and Power Co.

Prescott, Ariz.—The Prescott Electric Co.

Grand Forks, N. D.—Grand Forks Gas and Electric Co.

Phœnixville, Pa.—Schuylkill Valley Illuminating Co.

Wausau, Wis.—Wausau Electric Co.

Port Huron, Mich.—Port Huron Light and Power Co.

Paducah, Ky.—Paducah City Railway.

Brandon, Vt.—Neshobe Electric Co.

Binghamton, N. Y.—Binghamton Light, Heat and Power Co.

Helena, Mont.—Helena Light and Traction Co.

Dover, N. J.—Dover Electric Light Co.

Suffield, Ct.—Village Water Co.

Thomasville, Ga.—Thomasville Electric Light and Gas Co.

Keeseville, N. Y.—Keeseville Electric Co.

Chelsea, Mass.—Chelsea Gas Light Co.

Santa Fe, N. M.—Santa Fe Water and Light Co.

Alpena, Mich.—Alpena Electric Light Co.

Unionville, Ct.—The Union Electric Light and Power Co.

Peekskill, N. Y.—Peekskill Lighting and Railroad Co.

Columbus, Kan.—The Columbus Electric Co.

Pittston, Pa.—Citizens' Electric Illuminating Co.

Vergennes, Vt.—Vergennes Electric Co.

Brunswick, Me.—The Brunswick Electric Light and Power Co.

Portland, Me.—Consolidated Electric Light Company of Maine.

Litchfield, Ct.—The Litchfield Electric Light and Power Co.

Lexington, Mass.—Lexington Gas & Electric Co.

Ontario, Cal.—Ontario Power Co.

New Lisbon, Ohio—The New Lisbon Gas Co.

Aylmer, Quebec—Hull Electric Co.

THE DESIGNING OF TELEPHONE APPARATUS—XII.

BY W. A. TAYLOR.

The following are the dimensions of some repeating coils made by some of the prominent telephone manufacturers in this country.

The first coil to be mentioned is wound after the manner of Fig. 31. Diameter of core 0.75 inch, made up of No. 26 annealed iron wire, 14.5 inches long, and bent back over the spool after winding.

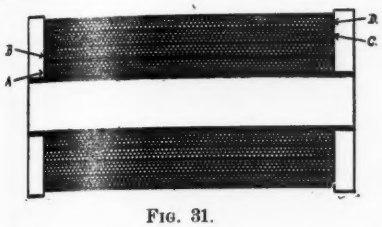


FIG. 31.

Insulation thickness between coils and next to core, one-thirty-second of an inch of paper. Length of winding space five inches, depth of winding space 0.625 inch.

Coil A, 2,700 turns, 2.67 ohms, No. 26 S. S. C. wire; coil B, 2,700 turns, 36 ohms, No. 26 S. S. C. wire; coil C, 2,700 turns, 45.5 ohms, No. 26 S. S. C. wire; coil D, 2,700 turns, 56.5 ohms, No. 26 S. S. C. wire. Resistance of the primary 83.2 ohms, 5,400 turns; resistance of the secondary 81.5 ohms; 5,400 turns.

This coil was made especially for ringing and showed great efficiency in that direction; it was also exceedingly good for talking purposes. This made a very large and heavy coil and was expensive to make. It also had the trouble of cross-talk in a great degree, so that an iron shell had to be provided for it.

The following is a smaller coil made by the same firm which was just as good for talking purposes, but was fifteen per cent poorer for ringing purposes. Size of wire, No. 29 S. S. C.; length of winding space, four inches; depth of winding space, one-half inch; diameter of core, 0.75 inch, made up of No. 26 annealed iron wires thirteen and one-half inches long, bent back over the outside as above.

Coil A, 2,400 turns, 44.5 ohms; coil B, 2,400 turns, 55.5 ohms; coil C, 2,400 turns, 65.5 ohms; coil D, 2,400 turns, 75.5 ohms. Primary, 4,800 turns, 120 ohms; secondary, 4,800 turns, 121 ohms.

A coil with the windings consisting of four parallel wires was of the following dimensions: Length of winding space, four inches; depth, one-half inch; diameter of core, 0.75 inch; length of core wire 13.5 inches No. 26 annealed iron, bent back and lapping over the outside of the coil. Number of turns each wire, 2,000; resistance, 52 ohms, and size of wire No. 29 double silk-covered wire. Resistance of primary and secondary, 104 ohms and 4,000 turns. This has a ringing efficiency about twenty per cent less than that of the largest coil above mentioned and talked fully as good as the best.

The following coil is intended solely for talking and gives the very finest results. It shows how much smaller a talking coil may be than one intended for ringing. This coil is also very efficient when used for central energy purposes. Length of winding space, one inch; depth of winding space, 0.375 inch; diameter of core, 0.375 inch; length of core, one and three-quarters inches; size of core wire, No. 26 annealed iron; size of wire with which it is wound, No. 32 single silk insulated. This coil is also wound with the concentric coils, as in Fig. 31.

Coil A, 977 turns, 10 layers, 22 ohms; coil B, 977 turns, 10 layers, 31 ohms; coil C, 977 turns, 10 layers, 37 ohms; coil D, 977 turns, 10 layers, 45 ohms. Primary, 1,954 turns, 20 layers, 67 ohms;

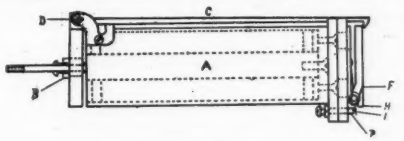


FIG. 32.

secondary, 1,954 turns, 20 layers, 68 ohms.

After winding, the coil is slipped into an iron shell and the ends closed with iron discs. The total diameter of the shell is one and five-eighths inches and its length one and seven-eighths inches.

It is, of course, not necessary to have an iron shell to cover the repeating coil,

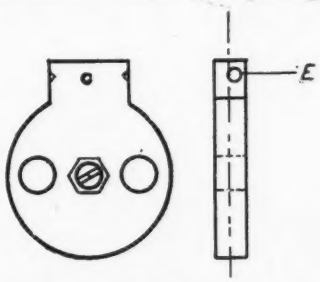


FIG. 33.

except where two or more are to be placed together closely. If the coils can be separated by a foot or more the necessity for the shell disappears.

THE SWITCHBOARD.

The apparatus for the making of connections between the different lines of an exchange is the most important part of the system. Because of the constant usage of the different parts of the switchboard, they must be made electrically and mechanically as nearly perfect as possible. The insulation must be first class and, at the same time, mechanically strong. Each part must be made accessible and so that it may be easily replaced. This is necessary because the majority of those who take

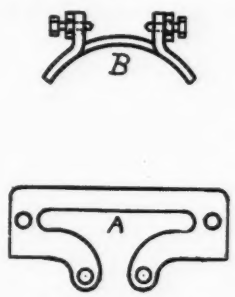


FIG. 34.

care of the apparatus are not sufficiently skilled workmen to do a good piece of work.

THE DROPS.

There are a number of different styles of drops used in switchboards now made, but undoubtedly the tubular drop is the best type yet designed. It presents an almost perfect magnetic circuit, occupies but little space and can easily be handled without danger of injuring the wire of the winding. Fig. 32 shows a sketch of this style of drop. The tube A is of iron or, what is just as good, mild steel. This is generally made of screw stock bored out. Some firms are using drawn shells with great success. These latter make a first-class tube and are quite cheap, especially for the larger-sized tubes. Where automatic screw machines are used and the size of the bore does not exceed five-eighths of an inch it has generally been found cheaper to bore the shells than to draw them. These shells, in either case, must be thoroughly annealed after the manner similar to that described in a former paper. These tubes or shells should have as great a diameter as is consistent with a reasonable-sized switchboard, in order that a maximum-sized magnet coil may be inserted. In general usage the outside diameter of the tubes vary from three-fourths to one inch with a wall one-sixteenth or three-thirty-seconds of an inch. The length generally approximates three times the diameter. The armature, B, is almost always the shape shown in Fig. 34. The extension at the top being made to receive the hook rod, C (Fig. 32), and the pivot screws, D. The pivot screws are pointed and project into holes, E (Fig. 33), in the edge of the armature. These holes should be placed a little in front of the centre of the edge of the armature, so that the stock of the armature will have a greater tendency to balance the hook rod.

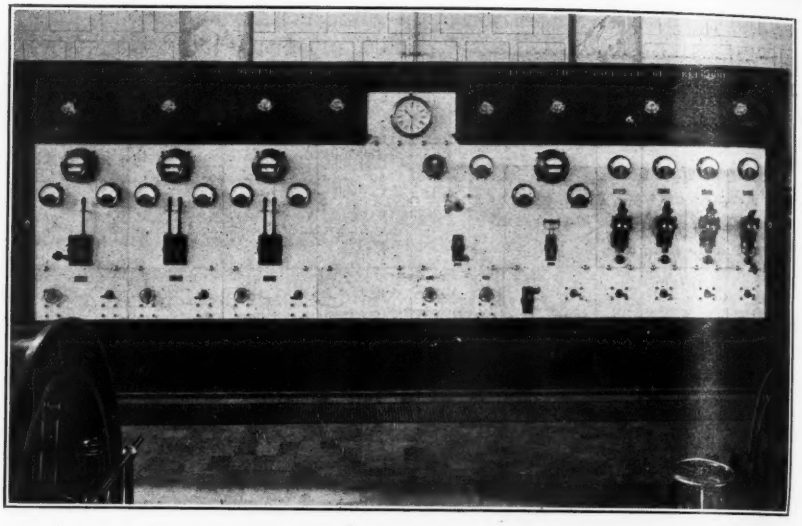
St. Gilles Electric Power and Luttiches Street Railway.

By Frank C. Perkins.

THE electrical installation of the "Société Nationale des Chemins de fer Vicinaux," of Brussels, was installed by the Maschinenfabrik Oerlikon recently and is now in operation. The arrangement of the St. Gilles central power station may be noted from the accompanying illustration of the interior. The power-house covers an area of 1,315 square metres, of which the engine room occupies 401 square metres and the boiler room 598 square metres.

The floor level of the engine room is four metres higher than the boiler room, the former being placed two metres higher than the ground level and the latter two metres below the outside level in order to facilitate the coal and water supply as well as the connections for the latter.

In the engine and dynamo room there are installed three direct-connected units, the engines being of the horizontal tandem-compound type. The steam generating plant consists of four boilers, of which one is held in reserve. The coal is carried from the storage room to the boilers in automatic coal cars operating on a narrow-gauge track. The boiler room and engine room are lighted by 120 incandescent lamps and eleven arc lights, and the workshop is equipped with lathes, drills and other machine tools, electric power being used. The shafting of the repair shop is driven by a seventeen-horse-power motor from the 550-volt circuit, the speed of the motor being 760 revolutions per minute.



THE FRONT OF THE BOARD, ST. GILLES STATION, BRUSSELS, BELGIUM.

THE REAR OF THE BOARD, ST. GILLES STATION, BRUSSELS, BELGIUM.

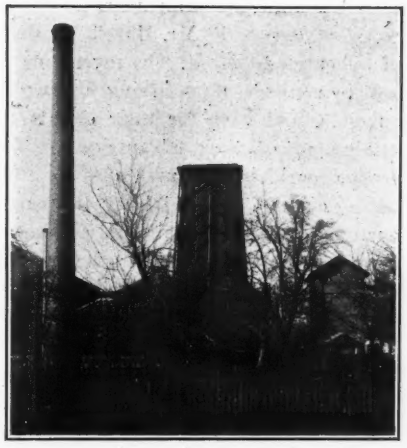
The smokestack is thirty-six metres high and 2.15 metres in diameter, the opening being 1.55 metres in diameter. The Galloway boilers operate at a steam pressure of 8.5 atmospheres with a normal output of 1,500 kilogrammes of steam and a maximum of 2,250 kilogrammes per hour. The boilers were constructed by the Société Anonyme de Chaudronnerie et Fonderie Liegeoises and have a heating surface of 100 square metres and designed for a pressure of nine atmospheres. The boilers are 2.2 metres in diameter and 10.4 metres long. The two heating tubes are 825 millimetres in diameter, and the dome has a diameter of 825 millimetres. Each boiler has eighteen Galloway tubes, and Siemens-Martin sheet iron is used, the bottom of the boiler being constructed of material twenty-two millimetres in thickness and the balance nineteen millimetres in thickness, while the fire-tube wall is fifteen millimetres thick and the dome wall fourteen millimetres, the bottom of the dome being of cast iron forty millimetres in thickness.

The Green economizer has 288 tubes in three groups. Rain water is used for feeding the boilers in connection with the city waterworks and the "La Haye" coal mine drainage for condensation purposes. The feed water is heated to a temperature of eighty degrees Celsius, and pumped by two Worthington pumps, having each a capacity of eighteen cubic metres per hour, one being held in reserve.

The engine equipment consists of three horizontal tandem-compound engines directly coupled to direct-current, shunt-wound generators. The engines are worked condensing and are supplied with Corliss-Bonjour valve gear. The engines were constructed by the Société Anonyme des Anciens Ateliers de Construction Van

den Kerchove of Ghent. The diameter of the high-pressure cylinder is 430 millimetres and the low-pressure cylinder measures 740 millimetres in diameter, while the stroke of the engine is 1,000 millimetres in length and the speed 120 revolutions per minute. The steam jacket of the high-pressure cylinder is heated by fresh steam and the low-pressure cylinder by dry steam from the high-pressure cylinder. The air pumps are located below and are driven from the flywheel. The engines each developed 320 horse-power at a pressure of eight atmospheres and fourteen per cent cut off and a useful output effect of eighty-six per cent, while 550 horse-power is obtained with a twenty-eight-per-cent admission and 91.5 per cent useful output effect. The steam consumption, with a normal pressure and 320 indicated horse-power at normal speed, is 5,800 kilogrammes per hour with the injector water at fifteen degrees centigrade.

The continuous-current generators are directly coupled to the steam engines by flexible couplings, and the dynamos are shunt wound, as they are used in connection with a storage battery plant. The pressure of these machines may be regulated by hand from 550 volts to 600 volts, and they are constructed to stand an overload of twenty-five per cent for several hours, the normal capacity of each machine being 250 kilowatts. The efficiency at full load is ninety-two per cent. The dynamos are of the Oerlikon multipolar type, the armature being 2,000 millimetres in diameter and the core width 400 millimetres. The machine has eight poles and operates at 120 revolutions per minute, and the laminated iron armature core has 506 slots, in each of which there are two copper bars, of a cross-section of 3.5 millimetres by 13 millimetres and 5.5 millimetres by 15 millimetres. At an output of 250 kilowatts and normal speed the current developed by the armature is 460 amperes.

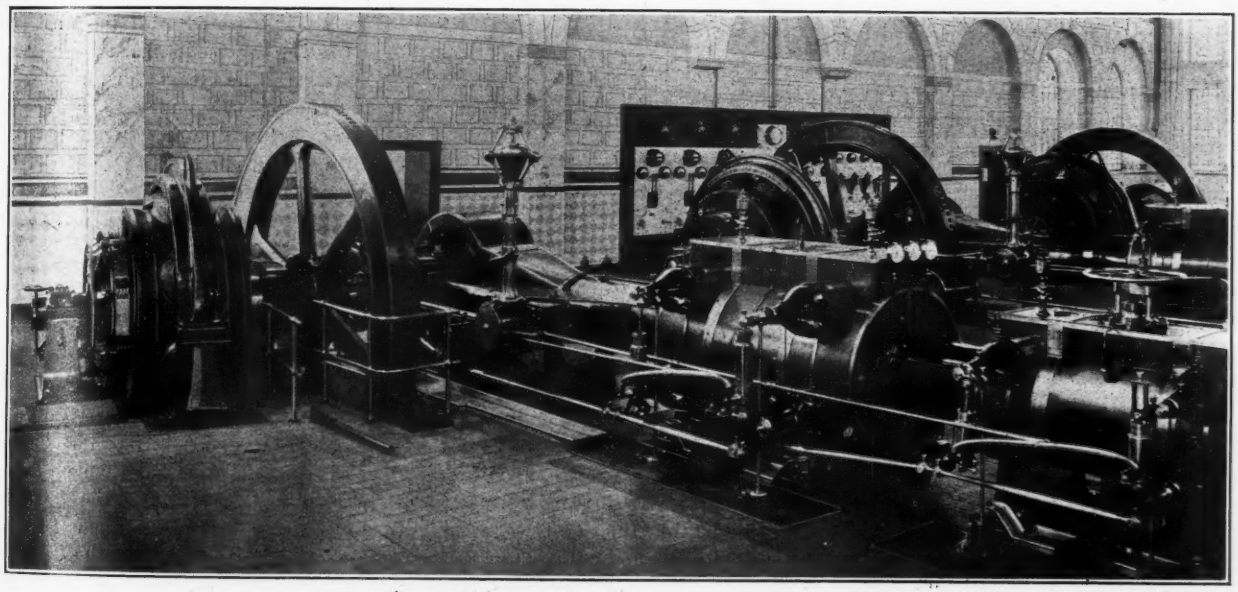


CHIMNEY AND COOLING TOWER, ST. GILLES STATION, BRUSSELS, BELGIUM.

The commutator of this machine has 506 segments, the width being 130 millimetres, while the diameter is 1,400 millimetres and there are eight sets of brushes, four in each set. The field poles are of cast steel 380 millimetres in diameter, and each of the shunt-wound coils has 1,500 turns of copper conductor, having a section 2.8 millimetres by 3.2 millimetres. The total weight of the field magnets is 6,500 kilogrammes for the cast steel and 1,150 kilogrammes for the copper, while the armature laminated iron weighs 4,700 kilogrammes, the copper bars 620 kilogrammes and the commutator segments 320 kilogrammes, making a total weight for the armature of 8.8 tons or more than 17,000 pounds. These machines when supplied with 370, 415 and 465 horse-power by the compound engines at normal full load and overload develop at a speed of 120 revolutions and a pressure of 550 to 600 volts, 250, 280 and 315 kilowatts and at full load (250 kilowatts), have an efficiency of ninety-two per cent. With half load the machine has an efficiency of eighty-seven per cent, and at two-thirds load an efficiency of ninety per cent.

The total efficiency of the electrical and steam units of this plant from the indicated output at the steam cylinders to the terminals of the generators is eighty-three per cent at full load and eighty-one and eighty-seven per cent at two-thirds load and one-half load, respectively.

Near the switchboard of this plant there is located a motor-generator set of twelve kilowatts capacity, for use as a booster in charging the storage batteries. The motor operates upon the 550-volt power circuit and has a capacity of fourteen horse-power, while the generator of the group, driven at a speed of 1,200 revolutions per minute, supplies a current of from 30 to 200 volts pressure, an insulated elating coupling being used in their direct connection.



THE INTERIOR OF THE ST. GILLES STATION, BRUSSELS, BELGIUM.

The front and rear of the switchboard at this plant, as well as the details of construction and connections, may be seen in the accompanying engravings.

The accumulator installation is 2.6 kilometres from the power-house, and

consists of 270 elements of a capacity of 290 ampere-hours when discharged at a 300-ampere rate. The voltage at the power-house is from 580 to 600 volts, while at the storage battery plant the pressure is regulated by the accumulators to from 540 to 550 volts.

The electrically driven transfer table in the car barns has a capacity of twelve tons and is twelve metres long. It has a speed of operation of forty metres per minute when fully loaded. It is driven by a nine-horse-power electric motor having a speed of 750 revolutions per minute, which receives its current from the 550-volt circuit. The weight of the apparatus complete is 14,000 pounds.

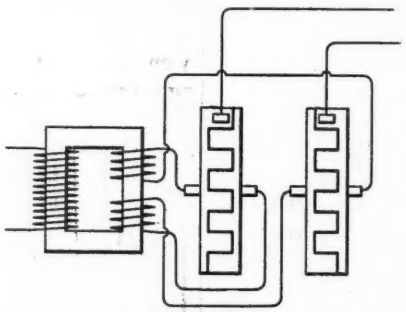
The power-house is operated day and night, and the staff consists of nine men, including two engineers, two assistant engineers and a chief engineer, as well as machinists and helpers. The total cost of the plant, excluding the building, was 500,000 francs.

Revision of the National Electrical Code.

A conference was held in New York, December 9 and 10, at which the rules and requirements of the National Board of Fire Underwriters for electrical wiring and apparatus were carefully considered. The conference was made up of advisory committees from the American Institute of Architects, the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Street Railway Association, the Factory Mutual Fire Insurance Company, the National Association of Fire Engineers, National Electric Light Association, Underwriters' National Electric Association, representing the National Board of Fire Underwriters, and the National Electrical Contractors' Association. The whole ground was very thoroughly gone over, and although no radical changes were made in the code, some minor alterations were adopted. A number of these were suggested by the advisory committee from the National Electrical Contractors' Association, which was called in for the first time at this conference. Official action in regard to rules for the regulation of the location and construction of extra high-pressure lines was, by request of the committee of the American Institute of Electrical Engineers, deferred, as the committee stated that new evidence was being submitted and it had not had time to give the matter the consideration which it deserved. The opinion that has been expressed in many quarters, that the National Board of Fire Underwriters could have no jurisdiction in this matter, was not concurred in by the conference. It is stated that the new code will probably be issued within the next six weeks.

Electrical Patents

The General Electric Company has obtained control of two patents issued on rectifiers, devised by Mr. Harold W. Buck, of Schenectady, N. Y. The inventions relate to methods of rectifying alternating currents, and have for their objects the attainment of such advantages as flow from a sparkless commutation of the alternating current. In rectifying alternating currents a commutator of well-known form is commonly employed, the function of which is to transpose the connections of the alternating-supply circuit with the work circuit as often as the current in the supply circuit changes sign, the result of which transposition is that the current in the work circuit is unidirectional, while that in the supply circuit is alternating. This transposition or commutation may take place in either of two ways. The

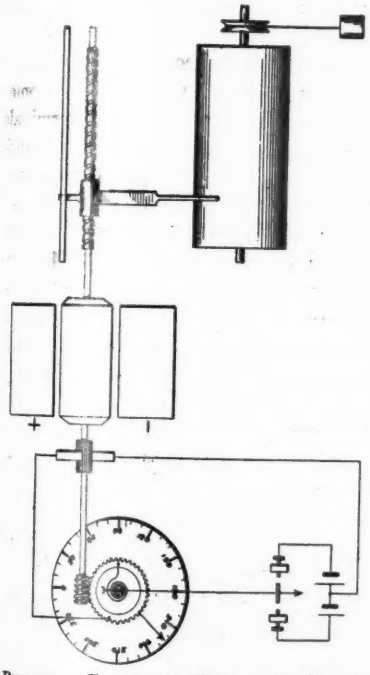


METHOD OF RECTIFYING ALTERNATING CURRENT.

supply circuit may either be wholly disconnected from the work circuit and then connected thereto, with the terminals reversed, or the commutation may take place by momentarily short-circuiting the supply circuit, as in the case where the commutator brush or brushes overlap the segments connected to the supply terminals. In the latter case, upon breaking the short-circuit by further rotation of the commutator, the supply terminals are connected in the reverse sense to the work circuit. In either of these cases, however, if the circuit be at all reactive, sparking will take place at the time of commutation. In the case where the supply circuit is first broken before reversing its connections sparking will take place, even though the break be made at the precise instant when the current passing has reached its zero value, and this because of the fact that the impressed electromotive force, being out of phase with the current, is acting at the instant of break and causes the current to jump across the intervening space as soon as the terminals are separated, rather than pass the alternative path formed by the inductive work circuit. The action is similar in the case where the supply terminals are short-circuited before being reversed. Upon breaking this short-circuit, current will jump across the intervening space formed as the terminals are being separated, rather than overcome the impedance of the reactive work circuit. A rectifying-commutator of the character referred to will not operate sparklessly without adjunctive devices except in the case of small currents flowing in non-reactive circuits. It is the object of these inventions to do away with this objectionable sparking and to accomplish the same without either breaking the work circuit or short-circuiting the terminals of the supply circuit. In carrying out this object a plurality of equal and similar sources of alternating electromotive force is made use of, preferably of such nature that the electromotive force of each source is in the same phase. One of these sources is first connected into the work circuit, and after operating until its electromotive force has passed through its predetermined range and becomes zero, another source, with its terminals reversed, is then connected into the work circuit in parallel with the first source. Upon the hypothesis that the work circuit is reactive the current in the source will not follow the impressed electromotive force, but will either lag behind or be advanced in phase with respect to the impressed electromotive force, so that when the impressed electromotive force becomes zero there will at that instant be a current flowing in the source of a value depending upon the amount of reactance. The second source of electromotive force is connected with the first in a direction such as to oppose a continuation of the flow of current in the first coil in its original direction after its impressed electromotive force has changed sign. It should be remarked that the two sources of electromotive force, although in parallel when considered with respect to the work circuit, are in series when considered with respect to each other. If the circuit of the first source be interrupted within the interval occurring between the instant when its impressed electromotive force becomes zero and when its current becomes zero, an induced electromotive force in the same direction as the current will be produced of a value roughly proportional to the value of the current. Within the interval mentioned the current of the first source decreases to zero, while the impressed electromotive force of the second source increases from zero. A point may

therefore be found where the induced electromotive force, due to disconnecting the source at the value which its current then has, is exactly equal and opposed to the resultant of the impressed electromotive forces of the sources, or, in other words, to the impressed electromotive force in the local circuit. If at this instant the terminals of the first source be disconnected no sparking will take place, because of the balanced electromotive forces then existing. Acting on the principle outlined, the inventions consist in connecting one source of electromotive force to the work circuit before another source is disconnected therefrom and causing the disconnection to take place at an instant such that the electromotive force due to disconnecting the source is approximately equal to the impressed electromotive force in the local circuit.

Messrs. Edward Weston, of Newark, and Adelbert O. Benecke, of Vailsburg,



Recording Electrical Measuring Instruments.

N. J., have obtained two patents on recording electrical measuring instruments, which are direct improvements upon instruments patented by Mr. Weston in 1893. The first invention has for its objects, first, to provide means whereby an increased range of record may be effected, and in such manner as to make a permanent record of relatively small changes either of differences of potential or of current flow or of the work being done in an electrical circuit, according to the type of instrument employed; second, to provide novel means whereby the recording stylus may be driven by a rotary movable armature capable of making either a fractional part of a revolution or a number of revolutions in either direction and in such manner as to give to said stylus wide ranges of movement over the record-receiving surface or sheet; third, to provide a power-driven recording mechanism in connection with instruments like those disclosed in the before-mentioned patents in which the record shall be placed upon a record sheet or surface on rectangular coordinate lines and in such manner that the spaced coordinates of the record as to time and as to quantity or potential or the work done shall bear a definite or fixed relation to each other; fourth, to combine with motor-driven part of the recording instrument a dampening device, which will instantly check the movement of the rotary part thereof, and hence the movement of the stylus when the propelling part is disconnected from the working source which drives it; fifth, to provide an armature core for the armature that drives the recording stylus which shall be of such a nature as to start and stop instantaneously on connecting or disconnecting the working current through or from the coils thereof, thus making the instrument far more accurate in its recording function than was possible with the instruments disclosed in the beforementioned patents. In each of the original instruments there is a vibrating recording arm which carries a stylus or pointer at its free end, said stylus being adapted to move over a record divided into coordinate lines indicating hours and amperes or volts, according to the type of instrument used. With such an instrument, however, it became necessary to vary the relation of the coordinate lines of the record representing amperes or volts in order to compensate for the angular variation of the recording stylus at the extreme limits of its movement. The present improvements are designed to overcome these objecti ns and to provide an electrically controlled recording instrument which shall give accurate records of differences of potential or changes of current or the rate of doing work in a system of electrical energy and of the time when such changes took place. In the second case the invention has for its object to provide an electrically controlled instrument adapted to be used with a measuring instrument, the movable part of which is controlled by a variable force, as the tension or torsion of a spring, and in such manner that the index needle of the instrument shall always be caused to return to a definite starting point, as the zero point, after any change has been imparted to it by the force to be measured. Such instruments have a very extensive use in the arts in connection with instruments of precision—such as electrical measuring instruments, barometers or instruments generally—the movable parts of which are controlled by the application of a continued torsional force.

Mr. Russell Spaulding, of New York city, has patented a process of forming conducting cables. He first forms a core from a plurality of fine wires. This is accomplished by braiding the cores about a former or mandrel, so that they shall be

Process of Forming Conducting Cables.

hollow and approximately circular in cross-section. After the tubular core is obtained, it is flattened to give it approximately a rectangular shape in cross-section. The core in its flattened condition is then run through a suitable apparatus to apply insulating covering, preferably the usual rubber composition. A single conductor may be placed in a cable of this construction or a plurality may be included in a single insulation, being insulated from one another by intermediate partitions or walls.

Mr. William H. Northall, of Elwood, Ind., has devised an improvement in magnet coils which are subjected to prolonged external heat, in which he employs asbestos as the insulating covering for the wire, this asbestos being formed into a string of twine. This is preferably formed of a plurality of strands, but as the material is of short tender fibre, a long fibre-holder or binder is used con-

Magnetic Coils for Prolonged External Heat.

sisting of strands of linen or other suitable thread, which has either incorporated with it or wrapped about it the central core of asbestos fibre, the threads, however, forming but a very small percentage of the total insulation. A coil constructed in this manner is claimed to be fire and heat-proof, and that tests have proven that an arc lamp coil constructed in this manner may be used indefinitely without charring and without short-circuiting. The entire coil may also be brought to a red heat without causing short-circuiting, for the reason that the vegetable fibre, though charred, forms so small a percentage of the total as not to interfere with the insulation.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

Commutation.

In this article Mr. H. St. H. Mawdsley describes a new type of pole-piece which has been found to give excellent results in commutating heavy currents. When first designed two wrought-iron straps were bolted to the magnets at the leading pole-tips and carried around to the trailing tips so as to form small poles at the neutral planes. The armature had, between the main core and the commutator, a narrow core over which the armature windings were carried. This part of the armature revolved in the field set up by the two straps just mentioned. When the leading tip was strengthened by cross-magnetization, due to the armature winding, these straps led around part of the field set up and produced an efficient commutating field at the neutral points. This field, of course, varied in intensity with the load on the machine. The device was found to operate successfully, but the method of applying it was undesirable. A modification of this was designed by Mr. J. W. Burleigh. In this the auxiliary core is done away with, and the pole-piece is made wider than the armature core, having practically a projecting band cast with the pole-shoe, starting from the leading tip and curving away from the armature and around the pole, and approaching the armature again just beyond the trailing tip. This construction calls for no alterations in the armature design, and has been found to give excellent results.—*Electrical Review* (London), December 5.

Care of Dynamos and Motors.

In this article Mr. F. J. A. Matthews discusses the attention which should be given to electrical machinery, particularly that installed in factories. The chief causes of breakdown are oil and dirt, the former by creeping over the insulation and allowing dust to collect, finally may cause a ground, or it may penetrate the windings and ultimately cause a burn out. Dust may be kept out by using an enclosed type of motor, but there is always present copper dust from the commutators, and the machine should be taken down occasionally that this may be wiped off. The importance of the proper adjustment of the brushes is emphasized and instructions given for the proper care of the commutator. The following causes should be looked for when a flat bar is found: Badly made joints in the belt, or vibrations of the machine due to insecure foundation; incorrect position of the brushes; loosely built commutators are very subject to flats. Protruding mica may start this trouble. Unequal hardness of individual bars, or a broken or imperfect joint in any armature coil will be sufficient to cause a flat. Although electrical machinery is more or less delicate, the services of an experienced electrician are not required in its care.—*Mechanical Engineer* (London), November 22.

Siemens Installations for the Purification of Water by Ozone at Weisbaden-Schierstein and Paderborn.

Last August the ozone purification works of Wiesbaden-Schierstein were put into actual operation. These are the first waterworks in Germany where ozonized air is used as a sterilizing and oxidizing agent in practical application. Dr. G. Erlwein here describes the installation, which was put in by the electrochemical department of the firm of Siemens & Halske. The plant is capable of handling a maximum delivery of 250 cubic metres of water per hour, yet the greatest demand at any time is not more than 125 cubic metres, so that a reserve of 100 per cent is provided. The plant is divided into two parts, each of which contains its own mechanical equipment, ozone apparatus and towers. To increase the reliability of the plant, each machine equipment can furnish current for the other section by simple manipulation of switches. Moreover, the ozonized air of each half can be supplied to either set of towers. The mechanical equipment consists of portable boilers and engines, driving continuous-current and alternating-current dynamos. The first drive motors for the deep well pumps, and the second furnish current for the transformers. These transform current from 180 volts to 8,000 volts for the ozone apparatus, from which the ozonized air is forced into the towers. Here the ozone, rising up through the tower, comes in contact with the water which trickles down through gravel and collects in a basin at the bottom, from whence it is forced into the high-pressure reservoir. The plant is divided by walls into three parts—the machinery hall, the ozone and transformer rooms, and the room for the sterilizing towers. In the machine hall are two sixty-horse-power Wolff portable boilers driving two continuous-current and two alternating-current machines. Here are also two centrifugal pumps, motor-driven, and two blowers for the air. The ozone apparatus is contained in the first floor of a two-story section. This contains forty-eight ozone apparatuses, divided into two sets. This apparatus is of the Siemens type and consists of three compartments. Air is forced into the lower and passes through the ozonizing tubes to the upper, and thence to the towers. In the central compartment water is circulated for cooling. The sterilizing room contains eight towers, four on each side. These are of masonry work. One of each set is held in reserve. These towers are about four metres high and filled with gravel for two metres. Water is sprayed in at the top and trickles down through the gravel. An automatic valve cuts off the supply whenever the electrical current is broken or the air supply is interrupted. It is stated that the cost of operation is 0.4 cent per cubic metre of water. Of this 0.1 cent is chargeable to the ozonizing process. This does not include interest or depreciation. The plant at Paderborn is similar to that just described, with the addition of a cascade chamber down which the purified water flows in order that it may be freed from ozone.—*Zeitschrift für Electrochemie* (Breslau), November 27.

High-Speed Electrical Generating Plant.

At a recent meeting of the British Institution of Civil Engineers, Mr. T. H. Minshall read a paper on "High-Speed Electrical Generating Plant," which is abstracted in this article. The paper was written with the object of comparing the relative advantages of high and low-speed combinations. The first part dealt with the relative adaptability of the two types. The causes which limit the increase of speed in engines and dynamos were first considered and the various types of valve gear then discussed. Vibration and means by which it has been overcome were touched upon. The author

showed that the speed of continuous-current combinations was limited by that of the generator, and the various difficulties connected with this problem were discussed. The speed of alternating-current combinations is, in general, limited by that of the engine. Tables were added, giving the comparative costs of high and low-speed electrical machinery in actual practice. The second part of the paper dealt with the relative efficiency of the two types of plant. Brake tests of engines are generally unsatisfactory, and the combined plant efficiency should be considered. This subject was considered at length and the effects of various details of design were shown. The third section of the paper dealt with the cost of maintenance, the figures dealing with the repairs and attention necessary in various stations being given. Finally, the author considered the capital cost of the bearing which the load-factor had upon the latter. A table was given showing the estimated cost of four power-houses, two of high-speed and two of low-speed machinery. The probable cost of production per Board of Trade unit generated with different prices of fuel and different load-factors was given, from which it was shown that the load-factor was by far the most important element in the determination of the type of machinery to be used.—*Engineering* (London), December 5.

The Theory of the Gas Mantle.

This article is a critical discussion by Mr. M. Solomon of the various theories which have been put forward of late to explain the high luminous efficiency of the Welsbach mantle. The simplest explanation is that put forward by Mr. J. Swinburne, which regards the mantle's luminosity as an ordinary high-temperature effect, and not at all due to selective emissivity. In this theory it is held that the temperature of the mantle is very nearly that of the Bunsen flame. The weak point of this theory arises from the fact that only poor radiators will approach the temperature of the flame, but these will have a poor light efficiency. Thus thoria will reach a high temperature but will give out little light, while ceria will radiate energy so rapidly that it will not approach the flame's temperature. To secure good light efficiency it is then necessary to add sufficient ceria to the thoria to increase the emissivity in order to get a good quantity of radiated energy, taking care not to lower the temperature unduly. La Chatelier and Nernst reach the same final result as Swinburne—namely, that the mantle is bright because it more nearly approaches the temperature of the flame than any other body similarly placed, but their experiments lead them to conclude that the emissivity of the mantle is poor in the region of the red rays. Hence, little energy is lost in non-luminous radiations. Bunte claims that it is unnecessary to assume selective emissivity and holds that the mantle is at a higher temperature than the flame. His view, which is supported by experiments, is that the catalytic action of the ceria, which oscillates between a high and low state of oxidation, increases the rate of combustion at the mantle's surface, and so raises the temperature. The thoria is necessary, according to Killing, to give a large surface over which this action takes place. The accuracy of these hypotheses has been tested by White, Russell and Traver, who, by the use of small thermocouples, have made relative determinations of temperature. Their results indicate that the mantle is at a temperature of about 100 degrees centigrade below that of the flame. A mantle containing 100 per cent of thoria, gave about one-tenth of the luminous output of that of a mantle containing ninety-nine and one-half per cent thoria and one-half per cent ceria, although the latter was at a temperature forty degrees less than the former. These experiments indicate that the efficiency of these mantles is a specific function of the material, more than of temperature. Professor Armstrong thinks that the luminous efficiency is due to an oscillatory chemical change at the surface of the mantle; that there is an alternating oxidation and reduction taking place several million times a second, and molecular shocks are produced which give rise to luminous oscillations of the ether, and the bodies become incandescent. The author comes to the conclusion that the most satisfactory explanation is that the high luminosity is due to a combination of the good radiating power, the high temperature, and the selective emissivity of the mantle. In other words, that all of these effects are present.—*Nature* (London), November 27.

A European 30,000-Volt, Three-Phase Power Transmission.

For the past two years the high-tension plant between Hochfelden and Oerlikon, built by the Oerlikon works, has been operated at 30,000 volts. The total average energy is supplied by two central stations, one at Hochfelden and one at Glattfelden, working in parallel, and amounts to 550 kilovolt-amperes. Each generator works on a three-phase transformer, and the ratio of conversion is 1 to 154. Under normal working conditions, two alternators and two transformers of the oil type are used. The high-pressure winding of one transformer is star-connected, and the coils of each phase of the second transformer are in series with the coils of the first transformer. The line is protected by three sets of lightning arresters of the Siemens horn type, situated at the beginning, middle and end of the line. The line is struck by lightning on an average of fifty times per annum, but no breakdown or serious damage has been recorded. An automatic regulator of the Thury pattern holds the voltage constant by changing the exciter current. The regulation is sensitive, holding the voltage within four per cent during ten seconds, although about 200 induction motors are operating in the different shops. Before working at 30,000 volts, very complete tests of the plant and line were made to ascertain how the charging currents affected the current and pressure conditions of the plant. Three distinct tests were made. Two transformers of the primary station without the line were switched on to the machines; then the line without the step-down transformers was thrown on, and finally the four transformers at the substation were added. For each test the voltage of the generator was varied from 30 to 116 volts, and the changes in generator current, line current, power output and power-factor were noted. Further, at the receiving end, the line current and secondary voltage, current, output and power-factor were noted. These figures show that the losses due to transformers and lines increase rapidly with increasing pressure. The charging current of the line was found to correspond very nearly to the value calculated from the capacity of the circuit. Some interesting figures were obtained, showing the effect of the negative difference in phase between the charging current and pressure. These show a rise of voltage in step-up transformers, due to this cause, of about twelve per cent. The efficiency determinations show a saving in transmission losses of about twenty-four kilowatts when operating at 30,000 volts, over that when operating at 15,000 volts. These tests showed a surprising unbalancing of the three phases, which was detected by driving a symmetrically wound induction motor, running light, from the line. Under these conditions, one phase of the motor was absorbing two-thirds of the total power, the second phase the remaining one-third, while the third phase was acting slightly as a generator. This unbalancing was found to be due to the arrangement of the line, the wires being placed at the three corners of a right-angle triangle. On changing this disposition of the wires, the absorption of watts per phase was much more nearly equal. A long series of tests was made, which showed a positive relation between line losses and conditions of weather.—*Electrician* (London), December 5.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Koerting Gas Engine.

The recent developments which have taken place in the utilization of waste gases from blast furnaces in gas engines have given a great impetus to the use of this apparatus for station work. In the accompanying illustrations are shown two views of the Koerting gas engine, which is the result of tests and experiments extending over a period of almost five years. The engine is of the double-acting two-cycle type, and the operation is as follows:

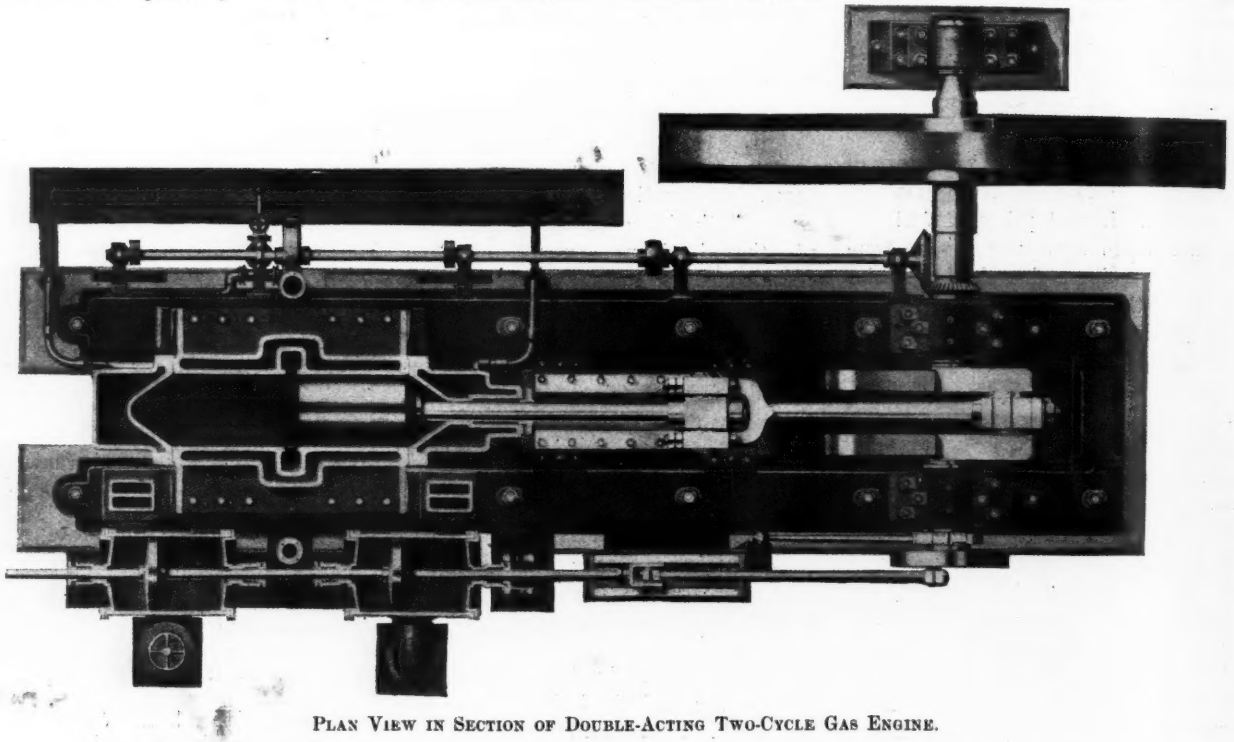
The engine is double-acting like a steam engine, hence the head end and the crank end of the power cylinder are similar, the admission valves being located in the valve boxes, which are bolted to the cylinder heads. There are no exhaust valves required, as the products of combustion escape through slots or ports cast in the middle of the cylinder, from where the exhaust pipe leads. These slots are covered by the motor piston itself. For this purpose, the piston is made very long and is packed at each end by the auxiliary self-closing spring rings.

The combustible mixture is admitted through two double-acting auxiliary pumps, one for gas, the other for air. These pumps are so proportioned that their combined action secures the proper mixture necessary for perfect combustion and introduces the same to the working cylinder. The compression spaces of the pumps are divided so that the crank ends of the air pump and the gas pump discharge into the crank ends of the power cylinder, and the head ends of the pumps discharge into the head end of the power cylinder. By the pumps the gas and water are compressed to about nine pounds per square inch.

Referring to Fig. 1 the piston is at the outer dead point, and the exhaust ports are exposed toward the opposite or head end of the engine. The instant the piston begins to uncover the exhaust ports, the pressure of the residual products of combustion in the cylinder drops rapidly to that of the atmosphere. When this has taken place, the inlet valve is opened and the fresh charge admitted by the pumps. The valve gear of this is so designed that air only is supplied first, to separate the burned gases from the succeeding mixture, and afterward gas and air, mixed in proper proportions. The combustible mixture of gas and air is produced only at the inlet to the cylinder. There is no storing of it, and this represents a very considerable advantage over engines that keep more or less of the combustible mixture outside of the working cylinder. By suitable construction of the admission device, the mingling of the air first introduced with the burned residue gases or with the succeeding charge of the combustible mixture is adequately avoided. For the same reason loss of mixture through the exhaust ports, which are open during this period, is effectively prevented.

Shortly after the exhaust ports are again covered by the receding piston, the air and gas pump pistons also arrive at their dead point position, and the supply of mixture is interrupted. The inlet valve closes, and the charge is compressed in the cylinder in the usual method until, at the dead point of the stroke, ignition takes place. At the next movement of the main piston, the ignited charge exerts its driving power by expanding until just before arriving at the other dead points, when the piston uncovers the exhaust ports again and allows the consumed charge to be blown out. On the opposite end of the piston the same operation takes place.

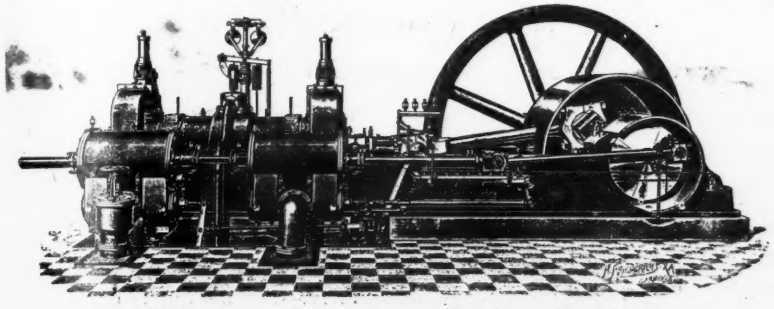
In order to secure the separating layer of air between the hot consumed gases and the fresh charge, the gas pump is so constructed that no gas is delivered until



PLAN VIEW IN SECTION OF DOUBLE-ACTING TWO-CYCLE GAS ENGINE.

after a certain point in its compression stroke. The pump is provided with piston valves, with the valve gear so arranged that its maximum capacity can not exceed fifty to sixty per cent of its total displacement. After the pump has completed the suction stroke, the gas suction port is left open during a portion of the succeeding (compression) stroke, so that the gas can return without increase in pressure until the suction port is closed, when the gas is compressed and passed out through the compression port. The amount of gas thus furnished corresponds to the maximum power of the engine.

Regulation of the power is effected as follows: When the load on the engine is reduced, the gas pump again begins to furnish gas at a correspondingly later period, thus discharging a diminished quantity of gas into the working cylinder. This is accomplished either by the valve gear of the pump, and controlled by the governor, or by a by-pass located between each pump end and respective compression channel which leads to the inlet valve on the main cylinder. The throttling device in this by-pass is also under the control of the governor.



SIDE ELEVATION OF DOUBLE-ACTING, TWO-CYCLE GAS ENGINE.

For ignition there are provided two spark coils at each end of the power cylinder. These are operated by a separate shaft driven by spur gearing from the cam shaft. The gear on the igniter shaft is not fast, being connected with a sleeve having a feather which is set spirally around the shaft so that by a sliding movement of the wheel the igniter shaft may be set behind or in advance of the cam shaft. Thus, the time of ignition can be changed during the running of the engine to suit whichever kind of gas is being used.

The engine is started with compressed air. Engines to which a blowing cylinder is attached are started with air under 150 pounds pressure; those without such cylinders require from 90 to 120 pounds per square inch.

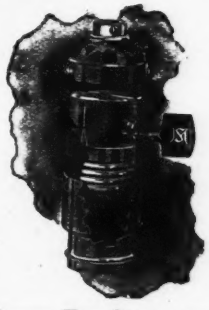
A piston valve is provided for admitting the compressed air at front and back ends of the cylinder. This piston valve is operated from the cam shaft by an eccentric which can be thrown in or out of gear like a clutch.

The power cylinder and piston are cooled by circulating water, which, in the case of the piston, enters the tube carried through the cross-head pin and hollow piston rod, and returns the same way, but on the outside of the tube. The stuffing boxes in the cylinder heads are surrounded by water. The cylinder walls are also cooled throughout, except at the middle, where the exhaust slots are placed.

This engine is built by the De la Vergne Refrigerating Machine Company, New York city, sole licensee for the United States.

New Insulating Socket Lining.

The Marshall-Sanders Company, Boston, Mass., has recently brought out a new insulation for lining sockets which is made from a special elastic fibre by a patented process which makes the lining expansible so that it can readily be forced into the socket shell by the fingers, and as easily removed; but it exerts sufficient friction against the shell so that it can not be shaken or dropped out, thus accomplishing the desired results in a workmanlike and entirely satisfactory way.



250-VOLT EDISON KEY SOCKET WITH ELASTIC FIBRE LINING.

The company reports a remarkable enquiry and many large orders for its well-known sockets with this style of lining, which is furnished without extra charge.

The B. & B. Commutator Truing Device.

A uniformly smooth commutator surface, concentric with the axis of revolution, is the prime requirement of efficient operation of any machine having a commutator. This is assured only by constant attention and the frequent use of some form of commutator truing device. While many causes may be enumerated for commutator troubles, the fact remains that the efficiency and durability of the machine are in direct proportion to the good condition of the commutator. The greater part of the users of direct-current apparatus has not at hand facilities for properly turning down commutators, and in many cases where such facilities are possessed, it is necessary to remove the armature of a large machine and mount it in a lathe in the machine shop, causing a loss of the use of the machine, which contingency is to be avoided if possible.

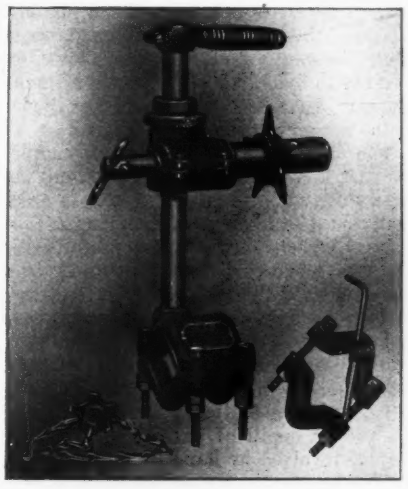


FIG. 1.—LARGE SIZE COMMUTATOR TRUING DEVICE.

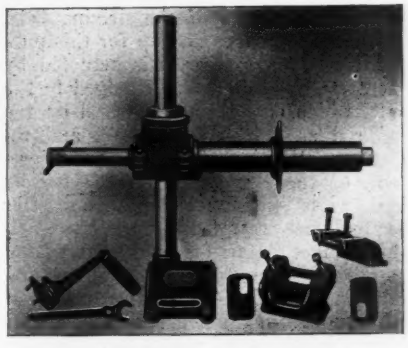


FIG. 2.—SMALL SIZE COMMUTATOR TRUING DEVICE.

To supply the demand for some convenient device for truing commutators which could be easily adapted to all sizes and makes of machines, without the removal of the armature, the Fort Wayne Electric Works some years ago developed the B. & B. device. This has since been adopted by a large number of street railway repair shops, central stations and ma-

chine shops in general, giving very satisfactory service wherever its adaptations are realized.

Figs. 1 and 2 show the complete assembly of two sizes of the device, with accessories for adapting them to various uses. In order that the many ways in which the device can be used may be appreciated by central station and repair men, photographs of this attachment, as adapted to machines of Fort Wayne manufacture, have been made, and are shown in the accompanying illustrations.

The complete device is very simple, compact and rigidly constructed, and has the capacity of a large lathe, and as ordinarily used can be operated by one person alone. A perfectly true commutator, with periphery concentric with the shaft, is a certainty with the use of the device, since it is mounted on the shaft bearings proper and the tool is applied to the commutator face while the shaft revolves in its own bearings. By means of a knurled adjusting screw, the tool may be set to make the proper depth of cut. The armature may be revolved by hand by means of the handle on the pulley, or at a slow rate

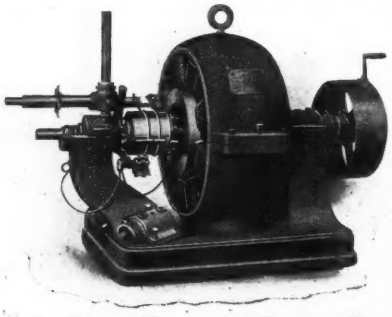


FIG. 3.—DEVICE MOUNTED ON BEARING PEDESTAL OF A 37.5-KILOWATT ALTERNATOR.

of speed by means of the driving belt, which should be loosened up for this purpose. The feeding screw is actuated by a bent steel rod or detent clamped to the shaft, which engages a star-wheel on the feed rod as the shaft revolves, and requires no attention after the first adjustment, or the star-wheel may be fed by hand, as is sometimes desirable. After the tool has traveled across the commutator face, leaving a true surface, and the device is removed, the fittings should be replaced and the machine driven at ordinary running speed, the tool marks being removed with a piece of ordinary grindstone, cut to convenient size and shape. The surface should then be finished with fine sandpaper.

Fig. 3 shows a large device mounted on the bearing pedestal of a 37.5-kilowatt alternator in place of the upper half of the bearing, which has been removed. The star-wheel on the feeding spindle may be turned by hand as the armature is revolved, causing the tool to travel across the commutator face at a uniform rate. This application of the device is typical of the great majority of cases where its use is so convenient. The device is stationary and attached to the frame of the machine, while the armature is revolved in its own bearings, thus producing a true, concentric commutator surface.

Another application of the large device to a machine, simply by the removal of the bearing cap, is shown in Fig. 4, where it is mounted on bolsters on the bearing pedestal of a 150-kilowatt machine. In this case, however, it is necessary to turn the feeding wheel by hand, as the shaft does not extend beyond the bearing to permit the use of the clamp. In fact, this method of feeding has been found more satisfactory in most cases than star-wheel feeding, especially for large machines.

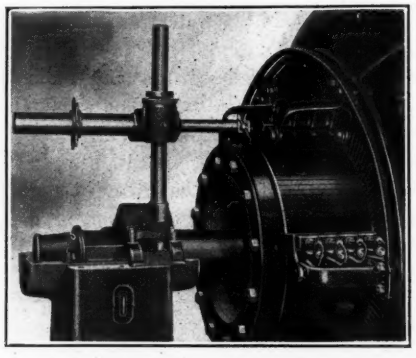


FIG. 4.—DEVICE MOUNTED ON BOLSTERS ON BEARING PEDESTAL OF A 150-KILOWATT MACHINE.

Another very satisfactory adaptation of this device with an entirely different type of machine is to move the armature far enough to one side to uncover sufficient of the shaft to mount the clamps directly on the shaft. The main clamp, on which the carrying post is mounted, is adjusted to fit closely, without binding, on the shaft, while the small clamp carrying the detent finger is firmly secured to the shaft and revolves with it. In this case the

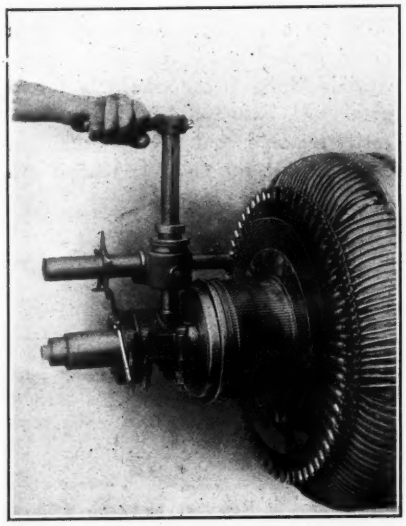


FIG. 5.—DEVICE MOUNTED ON ARMATURE SHAFT.

armature shaft is revolved in its own bearings and serves as a bearing for the clamp carrying the tool, thus securing perfectly true and concentric alignment. This adaptation is very desirable for use with the No. 9A "Wood" arc generator.

In many cases where ample time is available, and where space is insufficient to mount the device directly in the frame of a machine, it may be used as shown in Fig. 5. The clamps are adjusted so as to allow the main clamp and the supporting post to move freely around the shaft, but the small clamp carrying the detent finger is firmly secured to the shaft. In this case, however, the armature, instead of turning, is stationary and supported high enough from the floor to allow the device to revolve about the commutator with the armature shaft as a bearing.

Fig. 6 illustrates the device mounted for turning down a small commutator. The method, as described with Fig. 5, is employed in this case, but in order to adapt the device to the small shaft, both sets of clamps are reversed, giving a three-point instead of a four-point contact. In this way, the dvice may be used on the smallest shafts.

The B. & B. commutator truing device is made in two sizes only. The smaller size is designed for use only by mounting directly on the armature shaft or on a

FIG. 6.—TURNING DOWN COMMUTATOR OF SMALL ARMATURE.

certain size of bearing pedestal. The larger size can be mounted on the bearing pedestal or on some solid support beside the machine. By the proper combination of the bolsters with the various openings in the base of the device, this size may be used mounted on the bearing pedestal of most machines from 15 to 200 kilowatts capacity. For larger machines, it may be mounted on some solid support bolted to the frame or base of the machine, or to the floor, a little study revealing an almost universal use for the apparatus.

In the small size, the tool has a range of motion from two inches to twelve inches perpendicular to the centre of the line of shaft and six inches parallel with the shaft. When used mounted on the shaft, commutators under twenty-four inches in diameter, and with less than six-inch face, including flange, may be trued by this device.

The large-size device can be mounted on any pedestal having bearing cap-bolt holes more than four inches, and less than fifteen inches, apart. The tool in this case has a horizontal travel of twenty-one inches, beginning three inches from the inside bolt hole on pedestal, and a vertical motion of fourteen inches, beginning four inches from centre of shaft without bolster, and six inches from centre of shaft with bolster.

Electrical Semaphore Signals.

Not alone in the United States, but abroad, we are being constantly confronted with descriptive articles on electrical signaling apparatus for railway practice which possess characteristics of more or less value, both from a theoretical and practical point of view. While numerous systems for the safeguarding of rail traffic have been worked out on paper, the practicability of such a system is only demonstrated after a considerable period of usefulness. Although many systems which require the use of connecting wires for transmitting the current necessary to operate the switching and signaling apparatus have been devised, an apparatus which uses a system that eliminates line wires between home and distant block signals on double-track work is of deserved popularity.

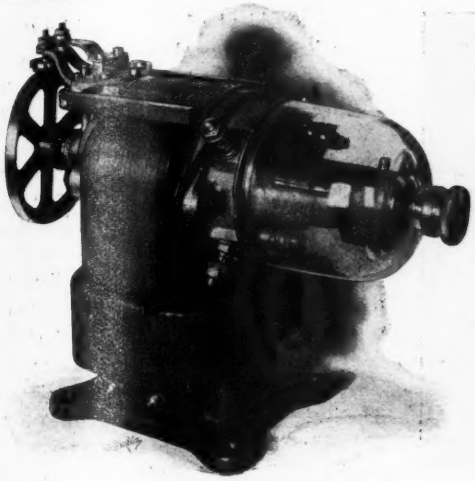


FIG. 1.—MOTOR; WITH COMMUTATOR SHIELD.

The Union Switch and Signal Company, of Swissvale, Pa., has had in operation for some time a polarized rail circuit, consisting of an electrical semaphore apparatus which is entirely under automatic control. Referring to the illustrations, Fig. 2 shows the internal and external connections peculiar to the control of this company's electrical semaphore by a polarized rail circuit. Each track circuit includes the magnets of a relay having a "neutral" and a "polar" armature, which control, respectively, the home and distant arms of the signal, marking the entrance of the block whose rails form the track circuit. Normally, when all blocks are unoccupied and when all switches thrown are properly set for main-line traffic, signals indicate the fact by displaying safety. The movement of a switch from the main line, or the presence of a train within a block, short-circuits the relay and, thus depriving it of current energy, causes the neutral armature to drop and to open the circuit signals, which immediately assume a horizontal position by gravity.

Each home signal is fitted with a pole-changing device which, as the signal moves to danger, changes the direction of the current in the track circuit preceding it and causes the polar armature of the relay at the other end of that circuit to shift and open the circuit of the distant signal there located, whereupon this signal assumes the caution position.

In the non-polarized system, two line wires are required between each home and its distant signal for the control of the latter by the former, the rails of the block section controlling the home signals only by non-polarized relays and track circuits of constant-current direction.

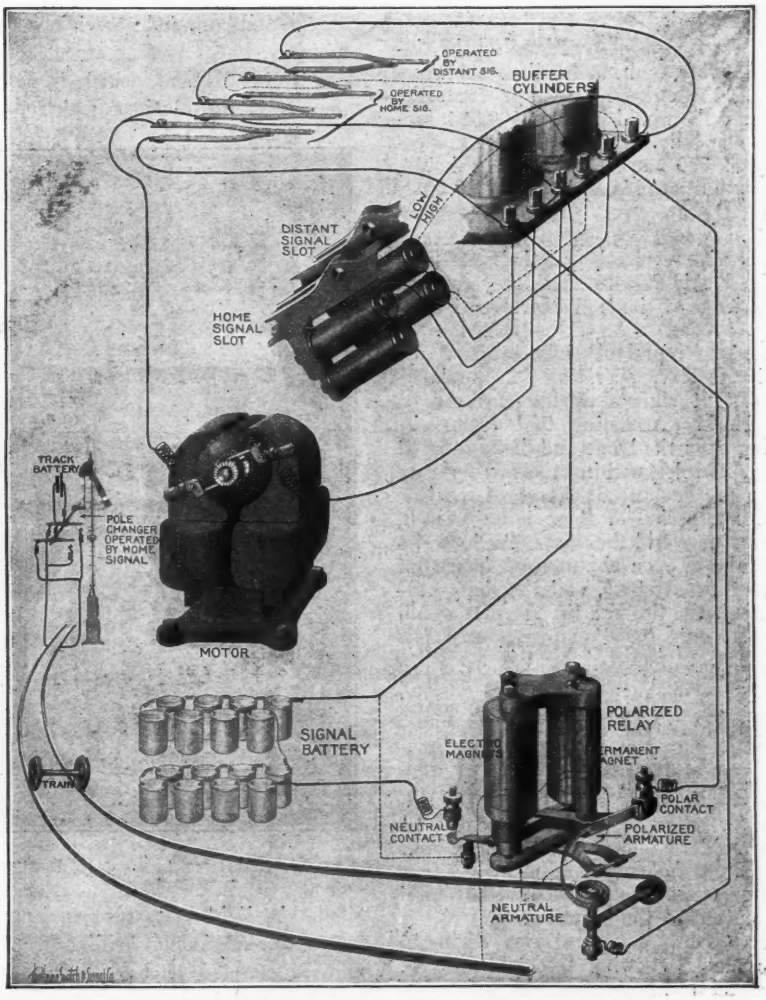


FIG. 2.—INTERNAL AND EXTERNAL CONNECTIONS OF POLARIZED RELAY CIRCUIT.

The reversal of the track circuit in the polarized system, besides causing the shifting of the polar armature of the relay, causes an instantaneous release and return of the neutral armature also. The momentary interruption of the home signal circuit thus produced would cause it, from the nature of the mechanism holding the signal at safety, to assume danger were it controlled directly by the neutral armature of this relay. Instead, the home signal is controlled by means of an intermediate relay of special design, having sufficient self-induction to cause a slow release of its armature when the current controlling it is interrupted. This interruption occurs for a fraction of a second only, during the reversal of current in the track circuit, and therefore has no effect upon the home signal.

While sixteen cells of caustic potash battery are recommended for operating and controlling this signal, this amount of battery may be decreased by modifying the motor and magnet windings to correspond with the requirements of a smaller number. However, it is not advisable to use less than sixteen cells, because primary batteries of the type employed develop in service a higher rate of effi-

ciency under a moderate than under a heavy discharge. The greater the number of cells employed, the less the discharge required for a given amount of work performed in a fixed time. Again, in inclement weather, and particularly during the winter, batteries are subjected to low temperatures, and there is also the probability of imperfect contact of the motor brushes with the commutators, which renders a high voltage desirable.

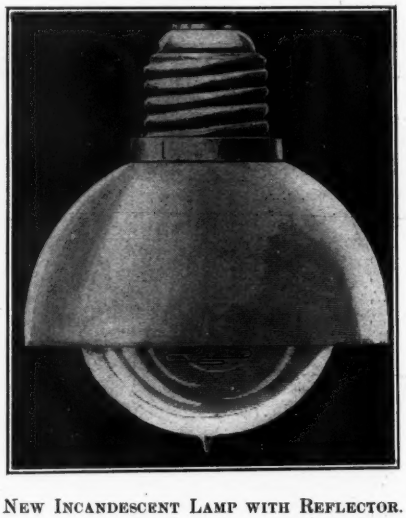
The following data have been prepared by the company in relation to the energy consumed by a two-arm signal operated upon the normally clear principle. When in the clear position, the magnets of the signal slots and that of the slow-releasing relay, all of which are normally in parallel circuit with the battery, entail a total current discharge of about 0.016 ampere. The current drawn from these cells during motor operation is slightly under two amperes, allowing for the initial discharge occurring at the instant the motor starts, and before its counter-electromotive force has developed. Were the batteries employed for the purpose of holding the signals at safety, and not for their operation as well, the current discharge from the sixteen cells would represent 0.384 ampere-hour daily. As the cells have a capacity of 300 ampere-hours, they should, for this purpose alone, last for 780 days, or slightly over two years, without renewals.

To arrive correctly at their capacity for the double duty to which they are put, a knowledge of the traffic involved is necessary. As an average, this traffic may be assumed to represent sixty trains daily, and hence sixty operations of the home and distant signals at the entrance of each block. Assuming that trains, by holding open the home and distant signal systems while within their respective blocks, prevent any discharge of the battery for a period of three minutes each, sixty trains would then cause the batteries to remain on open circuit three hours out of every twenty-four, and the daily current discharge through the magnets would represent only 0.336 ampere-hour. The average time required by the motor to clear each signal is 7.5 seconds, or 0.25 minute for both. Sixty trains would therefore cause the motor to operate for 0.25 hour daily. The average motor current being two amperes, 0.5 ampere-hour represents the daily output from the batteries for operating purposes alone. To this should be added 0.336 ampere-hour required for holding-clear purposes, thus making 0.836 ampere-hour the total daily output of the batteries.

Fig. 2 shows a general view of mechanism motor, showing the field-actuated brake and transparent shield over commutator. This shield is claimed to overcome a great many difficulties experienced from frost or dust accumulating on the commutator.

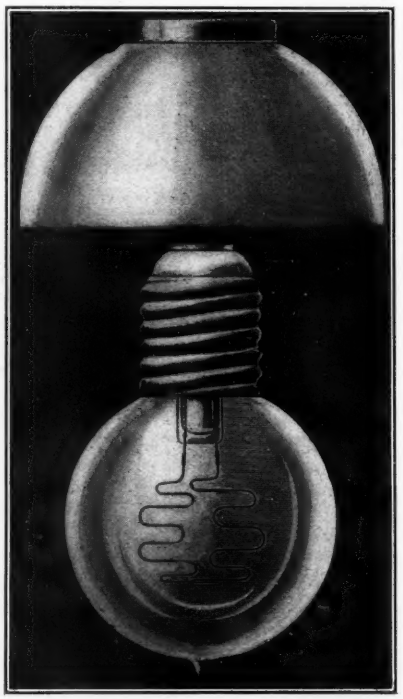
A New Type of Incandescent Lamp.

The accompanying illustration shows a new form of incandescent lamp which has been placed on the market by J. H. Bunnell & Company, 20 Park Place, New



NEW INCANDESCENT LAMP WITH REFLECTOR.

York city. This is an incandescent lamp with a round bulb and porcelain petticoat reflector. The chief feature of this lamp is the filament, which is moulded into several convolutions which so dis-



NEW INCANDESCENT LAMP WITH REFLECTOR REMOVED.

tribute the light as to give an illumination of remarkable brilliancy. This lamp is claimed to have an especially long life and high efficiency as well as strong illumination, and is very effective for show-windows, display rooms, halls and dining-rooms. It is being made for 104, 110, 115 and 118 volts, sixteen-candle-power 3.5 watts. J. H. Bunnell & Company are the sole agents for this lamp.

The International Congresses.

The president of the Exposition Company has announced the organization of world's congresses to be held in St. Louis during 1904. Howard H. Roberts, chief of the department of education, is to be the director of congresses. The advisory board working in conjunction with him is as follows: Chairman, Nicholas Murray Butler, president of Columbia University, New York city; William B. Harper, president of the University of Chicago; R. H. Jesse, president of the University of Missouri; Henry H. Pritchett, president of the Massachusetts Institute of Technology, and Herbert B. Putnam, librarian of Congress. The duties of this advisory board will be more exacting than usually fall to advisory bodies. Upon their recommendations will be determined the number and extent of the congresses, the emphasis to be placed upon special features, the prominent men invited to participate, the character of the programme and the methods for successfully carrying out the enterprise. A series of congresses has been an accompaniment of all recent international congresses. The work of the director and advisory board will be wholly given to constructing a coordinate department of the exposition which shall have an established scientific value and attract the attention of the scholars and experts of the world to St. Louis.

New York Electrical Society.

On Wednesday, December 17, Mr. Charles Day, Philadelphia, Pa., lectured on "The Requirements of Machine-Tool Operation, with Special Reference to the Motor Drive," before the New York Electrical Society, at the rooms of the American Institute, New York city.

In the first part of his lecture, Mr. Day pointed out the requirements of machine-shop equipment, dwelling upon the importance of thorough understanding of the elements to be dealt with.

The recent advance in the manufacturing of tool steel for roughing work, and the problem of machine design was considered at some length, as well as the course of experimental work, which must be followed up in order to determine the power to pull various cuts, the speed permissible under varying conditions, etc.

The question of machine-tool driving was taken up, including the relative merits of mechanical and electrical control, and the various systems of motor driving that are on the market at the present time briefly described.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MONTEREY TROLLEY LINE—Details of a plan by which a local syndicate will supply Monterey, Mex., with a modern trolley system have been completed. The Monterey Electric Railway Company, with a capital stock of $1,500,000 in gold bonds, and a bond issue the amount of which has not yet been announced, will be organized.

FORT WAYNE STREET-CAR SYSTEMS CHANGE HANDS—It is announced that interests involved in the Fort Wayne, Logansport & La Fayette Traction Company, which was incorporated to build a line from La Fayette, through Logansport, Delphi, Peru, Wabash, Huntington and intermediate points to Fort Wayne, and the company which is building a line from Fort Wayne to Lima, Van Wert and Delphi, Ohio, have effected a merger. The deal involves about $1,500,000. The Fort Wayne street-car system was owned by a Cleveland (Ohio) syndicate, headed by O. P. Eels, H. P. McIntosh and A. B. Garretson, of that city.

THE PENNSYLVANIA TUNNEL FRANCHISE PASSED—The Pennsylvania Railroad obtained, on Tuesday, December 16, from the board of aldermen, by a vote of forty-one to thirty-six, the right to tunnel under the Hudson River to the borough of Manhattan to the projected terminal of the company below Thirty-fourth street between Seventh and Ninth avenues; thence under the East River to the borough of Queens, to connect with the Long Island Railroad system recently acquired by the Pennsylvania company. The company proposes to spend $50,000,000 on the improvement, and in return for the franchise claims that the people of New York city will be given exceptionally good transit facilities. It is estimated that the tunnel will take at least three years, and probably five or six years, to be brought to completion. The minimum estimate cost of the improvements planned has been $50,000,000, but it is probable that the total outlay will approach $100,000,000. The general plan calls for the construction of a tunnel with a central and two substations in Manhattan, one on the east and one on the west side, and a terminal in Long Island. The operation is to be entirely electrical. The tunnel under the Hudson River, according to plans, is to be like a submerged bridge encased in a tube, which is to be supported by piers resting on piles driven into the river bottom to bed-rock. Immediately after the Pennsylvania franchise was granted, the board of aldermen granted the New York & New Jersey Railway Company the privilege of landing its Hudson River tunnel at West street. This franchise is for a tunnel from New Jersey for a trolley line, the tunnel to strike Manhattan at the foot of Morton street and to run up to Greenwich street. The plan of the company is to continue and complete the partly constructed tunnel under the North River, work on which is now being prosecuted on the Jersey side.

NEW YORK-BOSTON TROLLEY—Plans are now completed, the companies incorporated and the capital found for the construction of the final link in a system of trolley roads connecting Boston with New York city. This is a line from Hartford to New Haven. The backers will be Gay & Company, bankers, of State street, Boston, and James F. Shaw & Company, another banking firm of that city. These promoters, who jointly control some $40,000,000, are the principal stockholders and having controlling interests in two proposed lines between these hitherto unconnected cities, one running direct and the other *via* New Britain, Plainville, Southington and Cheshire. When the charter applications are made at the next session of the Connecticut General Assembly, it is reasonably certain that one of the two will be granted. Both the Gay and the Shaw interests are already operating roads in western Massachusetts, among others being largely represented in the line connecting Worcester with Boston. In the make-up of the through line this Boston-Worcester road will be the terminal. Between Worcester and Rockville, Ct., a forty-mile line is rapidly nearing completion. From Rockville to Hartford are the lines of the Hartford, Manchester & Rockville Street Railway Company, making an unbroken system from the Hub to the Connecticut capital. Then comes the break which the Boston firms are now planning to span. Beyond this, from North Haven, through New Haven to Woodmont, run the tracks of the Fair Haven & Westville Street Railway Company, and from there on the Connecticut Railway and Lighting Company, controlled by the United Gas Improvement Company, of Philadelphia, carries the line through Bridgeport, the Norwalks, and Stamford to Port Chester, N. Y. From there the New York & Port Chester road, which has recently gained the right of way for a four-track rapid transit system from the terminus of the New York city subway to the Connecticut line, will complete the through system. This latter road will overreach the Greenwich line, owned and operated by the New York, New Haven & Hartford Railroad Company, with which the latter for some time has completely blocked the plan for a through trolley from Boston to New York. From Boston to Hartford the Gay and Shaw interests will be the controlling factors; from Woodmont west to Port Chester, the Connecticut Railway and Lighting Company, known as the trolley trust, and from there on into New York city the Port Chester road. The Fair Haven & Westville Street Railway Company thus far has remained independent, but it is believed to be only a matter of time when this will be absorbed by the ever-growing Connecticut Railway and Lighting Company. In Hartford also there is an independent line in the form of the Hartford Street Railway Company.

WIRELESS TELEGRAPHY.

ANOTHER MARCONI WIRELESS TRIUMPH—It has been announced that wireless telegraph communication has been established between Cape Breton, Canada, and Cornwall, England, with great success. Inauguratory messages, including one from the Governor-General of Canada to King Edward VII., have already been transmitted and forwarded, and a message has also been forwarded to the king of Italy and several messages to different British and Continental newspapers. After a number of experiments, conducted with great secrecy, Mr. Marconi announces that he has solved the problem of transoceanic wireless communication. This formal announcement has been made by the inventor himself. George R. Rankin, a principal of Upper Canada College and a trustee of the Rhodes scholarship, was present when one of the successful tests was made. On December 14, 1901, a signal was transmitted by Mr. Marconi between Signal Hill, Newfoundland, and Poldhu, Cornwall, the telegraphic corroboration of this from the inventor to the ELECTRICAL REVIEW being published in the issue of December 21, 1901. Thomas A. Edison received the following message at Orange, N. J., Sunday, December 21, 1902, from Glace Bay, N. S.: "Remembering kind expression of your good wishes, take pleasure in informing you that I have established wireless telegraphic communication between Cape Breton, Canada, and Cornwall, England, with complete success. Inauguratory messages have already passed. G. Marconi." Mr. Edison responded at once as follows: "Sincere congratulations on your achievement."

AUTOMOBILE NOTES.

CAN NOT EXCLUDE AUTOMOBILES—William Keyser, president of the Baltimore Automobile Club, accompanied by the Chilian consul, Mr. R. J. Leupold, was arrested on December 19 for driving through the park in violation of the prohibition against heavy wagons and pleasure vehicles other than those drawn by horses. He admitted that he wanted to test the law, and Justice White decided the arrest unwarranted under the city ordinance which says that the park commissioners shall not be authorized to pass any rule or regulation excluding automobiles from the free use of any parks, squares or roadways under their control.

BY-LAWS OF AMERICAN AUTOMOBILE ASSOCIATION AMENDED—At a special meeting of the American Automobile Association, held December 9, the by-laws were amended so that the annual dues are now $1 per annum for each active, associate and life club member, payable semi-annually. This action was taken with the belief that all of the clubs in the United States not now members would, under such conditions, find it advisable to join the association, making it a thoroughly national and representative organization. The annual meeting of the association will be held at its headquarters in New York city, 753 Fifth avenue, on Tuesday, January 20.

ELECTRIC RAILWAYS.

DAYTON, OHIO—Surveyors are at work for the construction of an electric line from Springfield *via* Addison to Casstown, Troy and Piqua.

BUFFALO, N. Y.—A. E. Leon, Boston, Mass., has bought the Buffalo, Hamburg & Aurora trolley line for $51,500, and the same will be extended to Aurora as soon as possible.

CALEDONIA, N. Y.—A sixty-year franchise has been granted to the Buffalo & Depew Railroad Company to run an extension leading from Depew to Rochester through the village streets.

OLATHE, KAN.—The Olathe city council has granted a franchise to the Kansas City-Olathe electric line to enter Olathe. Work will begin immediately and it is expected to be in operation by June 1, 1903.

BUFFALO, N. Y.—The International Railway Company has just completed extensive improvements on the Lancaster line through the towns of Depew and Lancaster, and cars will hereafter be run on an improved schedule.

FLORENCE, COL.—Thomas Robinson has been granted a twenty-five-year franchise to construct and operate an electric street railway. The franchise requires that the work be started within four months, and by January 1, 1904, the road must be in operation.

MAUCH CHUNK, PA.—Work on the Mauch Chunk end of the new electric railway that is to connect Mauch Chunk, Nesquehoning, Lansford, Summit Hill and Tamaqua is not progressing very rapidly, and it will probably be next spring before the road will be completed.

TERRE HAUTE, IND.—The Western Traction Company, with a capital stock of $100,000, has been incorporated. The company is headed by S. W. Williams, of Vincennes, and will at once build an electric line from Vincennes to Sullivan, and then extend it to Terre Haute.

TORONTO, CANADA—The Sandwich, Windsor & Amherstburg Electric Railway Company purposes extending its line a distance of five and one-half miles south along the Detroit River. This will carry the line from Ojibwa to the town line between Sandwich West and Anderson.

COLUMBUS, OHIO—The Cincinnati, Dayton & Fort Wayne Railway Company, with a capital of $1,000,000, has been incorporated by S. F. George, C. W. Gebhart, J. F. Welliver, B. B. Levy and G. F. Giele. The road will run to Cincinnati and the Indiana state line, to connect as part of a system running to Fort Wayne, Ind.

WILMINGTON, DEL.—The charter for the West Chester, Kennett & Wilmington Electric Railway Company has been filed. It is for the Delaware end of the railway, extending from Brandywine Springs to the Pennsylvania state line. The road from the state line to Kennett Square has been completed. The line is likely to be in operation by January or February.

CHESTER, PA.—Through William R. Polk, of Birmingham, Ala., E. R. Cochran, Jr., has obtained an old charter for a trolley line between Middletown and Odessa. It is known as the Odessa & Middletown Railway Company. Mr. Cochran has secured rights and ordinances permitting the company to use streets in both Middletown and Odessa. The work of building the road will begin soon.

NEBRASKA CITY, NEB.—The Nebraska City Electric Railway Company has issued $100,000 in bonds in the denomination of $1,000 each, which it has sold to eastern parties. The bonds run for a period of fifty years and bear a low rate of interest. The company has the greater part of the material for the construction of its lines on hand and is laying the new track as fast as possible. It hopes to have in more than half the lines this fall and will lay the remainder in the spring and erect the power-house.

THORNTON, IND.—Articles of incorporation have been filed with the Secretary of State for the Consolidated Traction Company, which give the company the right to construct electric lines in and between the cities and towns of Indianapolis, Brownsburg, Jamestown, New Ross, Crawfordsville, Darlington, Lebanon, Frankfort, Whitestown, Zionsville, New Augusta, La Fayette, Stockwell, Colfax and Thorntown. The capital stock of the company is $300,000, and the directors are: E. P. Baker, A. M. Glossbrenner and Robert W. McBride.

ELECTRIC LIGHTING.

DUBUQUE, IOWA—The Union Electric Company will erect next year a new power-house to cost $200,000.

LEXINGTON, VA.—The Lexington Light and Power Company has just finished installing its new electric light plant for lighting the village, and the same is giving great satisfaction.

PETERSBURG, W. VA.—The Parsons Electric Light and Power Company's plant has been put in operation. The company is capitalized at $24,000, and Mayor H. K. Grubb is president.

PITCAIRN, PA.—The municipal electric light plant which this village is constructing is about completed, and will be placed in operation at once. The cost will reach about $20,000.

SPARTA, TENN.—The work of installing the plant of the Sparta Electric Light and Power Company is being pushed, and it is hoped that the lights may be turned on by the first of the year.

BALTIMORE, MD.—Mr. Daniel B. Banks, civil engineer of the United Railways Company, has purchased the stock of the Electric Light Company, of Elizabeth, N. J. The deal is said to involve $50,000.

MORGANTOWN, W. VA.—At a recent meeting of the Morgantown Lighting and Traction Company, contracts to the amount of $200,000 were let for material for the new power plant of the company, which will be completed by April 1.

ROCHESTER, N. Y.—It is stated that the General Electric Company is planning to install a lighting plant at East Geneva with which to furnish electricity for light and power purposes for Geneva, Waterloo, Seneca Falls and Auburn.

ROCHESTER, N. Y.—A deed has been filed in the county clerk's office formally transferring all the rights of the Central Light and Power Company, of this city, to New York capitalists headed by James Craig Havemeyer. The price paid is not stated, nor are the plans of the new owners made public.

JANESVILLE, WIS.—A trust deed for $150,000, covering all the property of the Janesville Electric Company, has been filed in the office of the registrar of deeds, J. W. Sale and W. S. Jeffris being named as trustees. This deed covers all the property of the company in this city and also at Fulton, and includes land, fixtures, water power and water lots of the company. Ten other deeds were made to the Janesville Electric Company before the trust deed was recorded.

TELEPHONE AND TELEGRAPH.

MANSFIELD, MASS.—The board of trade of the village is considering the plan of establishing a local telephone system.

UTICA, N. Y.—The Cassville line of the Home Telephone Company has been completed, and also the toll lines to other surrounding towns.

GREENVILLE, ILL.—The Mutual Telephone Company, of Montgomery County, has been granted a franchise to build its line in Greenville.

CORNING, N. Y.—The Bell Telephone Company contemplates making extensive improvements to its lines in this village, the work to begin about January 1.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company is extending its lines from McKeesport to Homestead, to connect with the lines between that place and Pittsburg.

MADISON, WIS.—The West Salem Telegraph and Telephone Company, of West Salem, has filed an amendment to its articles of incorporation, changing the name to the La Crosse County Telephone Company and the location of its head office to La Crosse.

BUFFALO, N. Y.—At the annual meeting of the Independent Union Telephone Company, held recently, it was voted to increase the capital stock of the company from $200,000 to $1,000,000. The increase is necessary for the purpose of connecting eastern, western and southern New York properties. This company provides long-distance lines to connect the independent telephone properties throughout the state and adjoining territory. The old officers of the company were reelected, as follows: President, Samuel B. Rawson; I. H. Griswold, vice-president; T. M. Brush, secretary and treasurer, all of Elyria, Ohio.

ELECTRICAL SECURITIES.

As compared with last week, business and speculative sentiment have undergone a most complete change. The panicky conditions which tended to more or less demoralization at the stringent appearance of affairs regarding the South American republic and the allied powers of Germany and England, which made a possibility of a rupture in friendly relations of these nations with the United States, have given way to a feeling of confidence in the assurance that nothing but the most conservative action will govern either belligerent of would-be peacemaker. The early part of the week recorded a decided break in the bad conditions which had been growing for some time, and following this period the rise in prices has been constant and well established. At the same time, the apprehension which has been felt as to a tight money market has been gradually ameliorated by the continued ability of spenders to meet all responsibilities.

The latest reports from the Bureau of Statistics as regards foreign exportations of manufactured products, while not regarded as favorable by some interests, are very large and show a considerable excess over anything we have seen for some time.

The reports of railroad earnings and industrials generally are favorable and reflect continued prosperity throughout the country.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 20.

New York:	*Closing.*
Brooklyn Rapid Transit	64½
Consolidated Gas	210
General Electric	176
Kings County Electric	212
Manhattan Elevated	146⅜
Metropolitan Street Railway	139
New York & New Jersey Telephone	162
Westinghouse Manufacturing Company	193

The Metropolitan Street Railway Company will pay a dividend of 1¾ per cent per share on the capital stock of the company January 15, out of and from the rent guaranteed and paid by the Interborough Street Railway Company on the lease dated February 11, 1902.

The Appellate Division of the Supreme Court has rendered decisions in various cases brought by the city to recover a tax of $50 on each car owned by a number of local road lines. The court decided that the Metropolitan Street Railway Company, as lessee in most of these cases, must pay the tax, which has not been paid for many years and aggregates a large amount.

Boston:	*Closing.*
American Telephone and Telegraph	161½
Edison Electric Illuminating	265
Massachusetts Electric preferred	93
New England Telephone	138
Western Telephone & Telegraph preferred	98

At the annual meeting of the Massachusetts Electric Company, after the acceptance of the annual report, stockholders reelected trustees to serve for three years by a vote of 115,336 shares of preferred and 73,269 shares of common stock.

Philadelphia:	*Closing.*
Electric Company of America	9⅝
Electric Storage Battery common	86
Electric Storage Battery preferred	86
Philadelphia Electric	8⅜
Union Traction	45⅝
United Gas Improvement	110½

The local market responded to the improvement in New York and became strong and active. Electric Storage Battery advanced 10 points to 85, all stock offered being taken by houses representing inside interests.

It is again rumored that merger, representing capital exceeding $200,000,000 and embracing the Philadelphia Rapid Transit, the United Gas Improvement and the Philadelphia Electric companies, is being considered by the Widener-Elkins-Dolan Syndicate, although representatives of this syndicate will admit nothing officially.

Chicago:	*Closing.*
Chicago Edison Light	175
Chicago Telephone	160
Metropolitan Elevated preferred	35¾
National Carbon common	27
National Carbon preferred	97½
Union Traction common	13½
Union Traction preferred	45½

PERSONAL MENTION.

PROFESSOR R. B. OWENS, of McGill University, Montreal, Canada, is visiting New York city this week.

MR. BLEECKER S. BARNARD, vice-president of the Standard Vitrified Conduit Company, spent a few days last week in Philadelphia.

MR. A. EDWARD NEWTON, president of the Cutter Company, of Philadelphia, Pa., has gone abroad and, it is said, will not return until early in February.

MR. C. E. BADEAU, who was formerly with the Wagner Electric Manufacturing Company, has opened an office for the Cutler-Hammer Company, of Milwaukee, Wis., at Pittsburg.

PROFESSOR SVANTE AUGUST ARRHENIUS has been awarded the Davy medal by the Royal Society for his application of the theory of dissociation to the explanation of chemical change.

PROFESSOR ELIHU THOMSON, of Lynn, Mass., was elected non-resident professor of applied electricity at a recent meeting of the corporation of the Massachusetts Institute of Technology, at Boston, Mass.

MR. T. L. LYMAN, manager of the asbestos department of the H. W. Johns-Manville Company, sailed on December 20 for Havana, Cuba, where he will remain for several weeks for the benefit of his health.

MR. BEECHER OGDEN has joined the staff of the H. W. Johns-Manville Company, New York, as assistant in the advertising department. Mr. Ogden is experienced in this line of work, having been engaged in it for several years.

THE HON. CHARLES A. PARSONS has been awarded the Rumford medal for his success in the application of steam turbines for industrial purposes and for its recent extension to navigation at the anniversary meeting of the Royal Society, London.

PROFESSOR JOSEPH J. THOMSON has been awarded the Hughes medal in recognition of his contribution to the advance of electrical science especially in connection with the phenomena of electric discharge through rarefied gases, at the anniversary meeting of the Royal Society.

PROFESSOR W. S. FRANKLIN, professor of physics and electrical engineering, and Professor William Esty, associate professor of physics and electrical engineering, Lehigh University, were visitors to the office of the ELECTRICAL REVIEW, and later attended the meeting of the American Institute of Electrical Engineers last week.

MR. CLARENCE MACKAY, Mr. G. G. Ward, Mr. W. H. Baker and Mr. E. C. Bradley officials of the Commercial Cable and Postal Telegraph Company, and Mr. W. L. Candee, manager of the Okonite Company, have returned from San Francisco where they attended the ceremonies connected with the laying of the shore end of the new Pacific cable.

MR. MAX CAZIN, master electrician United States Navy Yard, Cavite, P. I., writes that there is great interest being manifested in electrical apparatus for utilization on the sugar plantations. There is an opportunity here, he says, for manufacturers of American apparatus to make good use of catalogues and descriptive matter of motors and dynamos, wiring material, cane grinding machinery and water-wheels.

MR. EDWARD H. ROLLINS, electrical and constructing engineer, 26 Cortlandt street, New York city, who was formerly in the new and second-hand electrical and steam machinery business, has been appointed superintendent of the power department for the Cheney silk mills, of South Manchester, Ct., and has sold out his business with the good-will and a very complete stock of engines, boilers and electrical machinery to B. W. Payne Company, 39 Cortlandt street, New York city, which is already carrying a large line of similar apparatus.

INDUSTRIAL ITEMS.

THE ELECTRIC APPLIANCE COMPANY, Chicago, selling agent for the Adams-Bagnall arc lamps, has just issued a booklet entitled "Twenty Chapters of Reasonable Arc Lamp Talk." A postal card request to the company will secure one.

THE HOLTZER-CABOT ELECTRIC COMPANY, Boston, Mass., illustrates a fine line of dynamotors and motor-generators in bulletin No. 139. These are for plating, charging, ringing and testing currents. This bulletin will be sent to any one interested upon request.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., as an evidence of the durability of its apparatus, has published two letters referring to the success which has attended the installation of these transformers in two plants, one at Jenkintown, Pa., and the other at Quebec, Canada.

THE EUREKA ELECTRIC COMPANY, Chicago, Ill., is supplying an entire new equipment for the Capital City Telephone Company, Pierre, S. Dak. Extensive improvements are being made under the direction of Mr. W. S. Rowe, general manager, who is installing the first underground cable in the state.

THE ELECTRICAL EQUIPMENT COMPANY, contracting engineers, suite 930 Monadnock Block, Chicago, announces that Mr. J. Holt Gates has retired from the presidency of this corporation, having disposed of his interests therein, and is no longer connected with the company in any capacity whatsoever. Mr. J. W. Peterson has been elected president and will continue in the active management of the business.

THE LUKENHEIMER COMPANY, Cincinnati, Ohio, is very busy keeping up with the heavy demand for its metal products. The opening of its large new factory has given it a great many added facilities and the company is prepared to make prompt shipments of large orders. An attractive leaflet, which the company is now distributing, illustrates its armed body, brass mounted, globe angle, cross, check and swing check valves. These are mounted in screw and flange ends from two inches up. Complete catalogues of brass and iron engineering appliances will be sent on request.

THE MARSHALL-SANDERS COMPANY, Boston, Mass., is just putting upon the market a new improvement in socket construction consisting of an elastic fibre insulating lining. This is of such construction that it is unnecessary to mutilate the shell to prevent the lining from dropping from the socket, and while it can be easily removed from the shell it can not be shaken out by accident or carelessness. The Marshall-Sanders Company is represented in Chicago by Messrs. Hart & Company, Monadnock Building, with whom has been placed a full line of all its specialties, sockets, switches, cutouts, plugs and receptacles.

THE SAMSON CORDAGE WORKS, Boston, Mass., has just issued an attractive catalogue and price list of its solid braided cords and cotton twines. These solid braided cords have proved to be very durable in running over pulleys and have great freedom of play without slipping. A specialty of interest to engineers and construction men is the Samson railroad signal cords and trolley cords with weather-proof finish. Another specialty is the Samson arc light cord which is constructed of a smooth hard braid which runs easily over the pulley with very little abrasion. This catalogue will be sent to any one upon application.

THE RITTENHOUSE-MILLER COMPANY, 923 Witherspoon Building, Philadelphia, Pa., is the manufacturer of the Eureka flexible conduit. This conduit is claimed to have many features of value and is so constructed as to be moisture-proof, and at the same time flexible to a great degree. The interior is coated with a high grade of Italian talc which further increases the facility with which the wire may be installed. The outside covering is made of thick, tough fibre which will withstand all abrasion. The whole conduit is treated with fire-proofing compound and then covered with an enamel baked on the conduit at high temperature.

THE CAMBRIDGE ELECTRIC LIGHT COMPANY, Cambridge, Mass., is about to displace the direct-current power distribution system for an alternating-current system. The company has recently purchased from the Westinghouse Electric and Manufacturing Company ninety-nine induction motors, which will take care of the bulk of the power service, comprising every possible use of electric power, in a city of this kind, from public works to small tailoring establishments. The order given is for eleven 1-horse-power motors, twenty-six 2-horse-power motors, nine 3-horse-power motors, nineteen motors of 5-horse-power, twenty-five of 7½-horse-power, and nine motors of 15-horse-power.

SYRACUSE, N. Y.—Messrs. W. P. Gannon and E. G. Connette, of the Syracuse Rapid Transit Company, announce that they have closed a deal for the street railway system of Oswego, operated by the Oswego Traction Company. The purchase includes all of the first-mortgage bonds of the Oswego company, and all but ten per cent of the capital stock and second-mortgage bonds. The company's capital stock amounts to $300,000, the first-mortgage bonds to $97,000, and the second-mortgage bonds to $191,000, outstanding. The company operates eleven and one-half miles of railway, including all in Oswego, with lines running out to Beach Oswego and Minetta.

THE HAINES & NOYES COMPANY, Chicago, Ill., has become affiliated with Couch & Seeley Company, telephone manufacturer, Boston, Mass., and will in future be the western agent of the Couch & Seeley Company with offices in Chicago, carrying a large stock of telephone apparatus made for western selling. The Haines & Noyes Company has been in existence but a little over two years and in this time has built up a very large business. All communications or orders from the West, including the western part of Canada and Mexico, will be directed to the Haines & Noyes Company, and communications and orders in the East should be directed to the Couch & Seeley Company, Boston, Mass.

THE UNION RAILWAY COMPANY, New York city, is about to complete a large substation at West Farms, N. Y., for which it has purchased from the Westinghouse Electric and Manufacturing Company a large amount of apparatus, including three 1,000-kilowatt, three-phase rotary converters with starting motors which have cooling oil-insulating transformers and alternating and direct-current switchboards and the transmission will be at 6,300 volts and 3,000 alternations. The alternating-current switchboard will be equipped with the new Westinghouse type C, oil-break, electrically operated switches. The Bayard street station of the Metropolitan Street Railway Company, of New York city, is also being equipped with these switches.

THE ECONOMICAL ELECTRIC LAMP COMPANY, 123 Liberty street, New York city, is manufacturing two types of turn-down lamps. One type is intended for use where the lamps are located some distance overhead and are equipped with two cords through which the lamps can be operated, using the bright light or the dim light by pulling the cord designating the light desired. The cords can be lengthened or shortened to suit the distance they are placed above the ground. The other type manufactured by the company is operated by simply turning the bulb from right to left and then again from left to right. In turning the bulb to the right, the current is thrown on the smaller filament and a dim light shown, and by turning it back to its original position, the current is reversed to the larger filament and the light consequently brightened. The company announces a large sale of these lamps throughout the United States, and great increase in orders during the past three months.

THE EASTERN AUTOMATIC TELEPHONE COMPANY, Boston, Mass., has made great strides in eastern New England. Since the commencement of business in 1899, with its exclusive rights for the Strowger automatic exchange system for the states of Massachusetts and Rhode Island, automatic installations have been launched in the cities of Fall River and New Bedford, Mass., and in the town of Westerly, R. I., in all of which places the service given has increasingly won the approval of the telephone users. The latest move of this company is the appointment of Mr. B. E. Waters as general manager, with headquarters in Boston. Mr. Waters is well known among telephone men, having been manager of the Brockton exchange of the Southern Massachusetts Telephone Company, and later general manager of the Southern Massachusetts Telephone Company. Upon the purchase of the Southern Massachusetts company by the New England Telephone and Telegraph Company, Mr. Waters became superintendent of the southern Massachusetts division of the company.

ELECTRICAL REVIEW

VOL. XLI—No. 3. NEW YORK, SATURDAY, JULY 19, 1902. TEN CENTS A COPY. THREE DOLLARS A YEAR. FIVE DOLLARS FOREIGN.

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THE PHOENIX GLASS CO.
Manufacturers of
Gas and Electric Globes, Shades, Etc.
Send for our LATEST CATALOGUE Now Ready
PITTSBURGH
NEW YORK
CHICAGO

HYLO
Advertisements on 24 pages in this issue
THE PHELPS CO., 29 Rowland St., Detroit, Mich., U. S. A.

AMERICA'S LARGEST ELECTRICAL SUPPLY HOUSE
ELECTRIC APPLIANCE COMPANY, NINETY-TWO & NINETY-FOUR WEST VAN BUREN STREET, CHICAGO

THE BRISTOL CO.
WATERBURY, CT.
Recording Voltmeters
Recording Amperemeters
Recording Wattmeters
Recording Pressure Gauges
Recording Thermometers
PAY FOR THEMSELVES
SEND FOR CATALOGUE

WILLARD L. CANDEE, H. DURANT CHEEVER, } Mgrs.
GEO. T. MANSON, Gen. Supt. W. H. HODGINS, Secy.
1889 PARIS EXPOSITION MEDAL FOR RUBBER INSULATION
OKONITE
TRADE MARK
1893 WORLD'S FAIR MEDAL FOR RUBBER INSULATION
THE STANDARD FOR RUBBER INSULATION.
Sole Manufacturers of OKONITE WIRES, OKONITE TAPE, MANSON TAPE, CANDEE WEATHERPROOF WIRES. Write for Prices.
THE OKONITE CO., Ltd., 253 Broadway, New York.

N. I. R.
WIRES AND CABLES.
NATIONAL INDIA RUBBER CO.
Factory and General Offices:
BRISTOL, R. I.

Schlesinger & Mears
Manufacturers of
Electrical Specialties
No. 220 BROADWAY, N. Y.

THE NATIONAL CONDUIT & CABLE CO.
Manufacturers of BARE COPPER WIRE AND CABLE,
PAPER INSULATED CABLES FOR TELEPHONE, TELEGRAPH, ELECTRIC LIGHT AND POWER.
CEMENT LINED PIPE FOR CONDUITS.
Executive Offices, Times Building. NEW YORK, N. Y.

Bullock
ELECTRIC MFG CO.
CINCINNATI, O. U.S.A.

WARREN ELECTRIC AND SPECIALTY CO. WARREN, O., U.S.A. Manufacturers
"PEERLESS"
INCANDESCENT LAMPS, FAN MOTORS, TRANSFORMERS

MONTAUK FIRE DETECTING WIRE CO.
Only Fire Detective Wire in the World. 100 BROADWAY, NEW YORK CITY.
"Approved by the New York Board of Fire Underwriters, February 20, 1901."

AMERICAN ELECTRICAL WORKS
BARE and INSULATED ELECTRIC WIRE
MAIN OFFICE AND FACTORIES - PHILLIPSDALE, R. I.

STANDARD UNDERGROUND CABLE CO.,
FIBER PAPER RUBBER ELECTRIC CABLES, FOR ALL CLASSES OF SERVICE
HIGH-GRADE RUBBER COVERED AND WEATHERPROOF WIRES. Telephone, Telegraph, Electric Light and Power.
Westinghouse Bldg., Pittsburgh, Pa.; 26 Liberty St., New York; 1225 Betz Bldg., Philadelphia, Pa.; 322 The Rookery, Chicago, Ill.; Wells Bldg., San Francisco, Cal.; 101 Milk Street, Boston, Mass.

ALL OUR WIRES—NEW CODE STANDARD
NEW YORK INSULATED WIRE COMPANY
Main Office: 114, 116 and 118 Liberty St., New York Branches: CHICAGO, 192 Desplaines St.; BOSTON, 7 Otis St.; SAN FRANCISCO, 33 Second St.
CRIMSON WHITE CORE INSULATED WIRE

THOUSANDS IN USE.
Bipolar and Multipolar Motors from 1-2 to 50 H.-P. Dynamos from 10 lights to 200. We sell or rent. Good profits for Agents.
THE HOBART ELEC. MFG. CO. TROY, OHIO.

KEYSTONE MEASURING INSTRUMENTS I-T-E CIRCUIT BREAKERS

"American" Storage Cells are the best.
Send for descriptive circular.
Absolutely Non-infringing. Protection Guaranteed.
AMERICAN BATTERY CO.,
Est'd 1889. 172 S. Clinton St., Chicago, Ill.

Punched Mica
We are furnishing many shapes
We would like to make you price
Write for quotations
American Mica Co.
275 Congress Street
Boston, Mass.

Bishop Wires and Cables
meeting the most trying conditions a specialty
WIRES
for Car Work, Power, Light or Heating
CODE WIRES AT CODE PRICES
BISHOP GUTTA-PERCHA COMPANY
422-426 EAST 25TH ST., NEW YORK

SIMPLEX WIRES AND CABLES
For UNDERGROUND, SUBMARINE LINE and INSIDE CONSTRUCTION.
SIMPLEX ELECTRICAL CO.
75-81 Cornhill, Boston. 1127 Monadnock Block, Chicago.

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HYLO

EDITORIAL

In this issue of the Electrical Review our advertisement appears on **24** pages. This is not because of any vain-glorious desire to break the record or to out-Marsh Mr. Marsh, but because the scope and importance of the HYLO idea requires large space. A full exposition of the utility and convenience of the HYLO lamp transcends the limits of any ordinary advertising page; hence, we employ in this issue extraordinary space which we are confident will carry knowledge and conviction to every man connected with the electrical industry.

The luxuries of to-day become the vital, every-day necessities of to-morrow. Only yesterday the incandescent lamp ranked as a luxury. The standard of good living to-day puts it down as a necessity.

We have reached a stage in the development of electric lighting when a turn-down lamp is demanded, when it is absolutely essential to good service everywhere. Such a demand was to have been expected as a result of the natural evolution of the idea of comfort. It could not be supposed that the world would go on from June to Eternity using the inflexible, common lamp, which is "all on" or "all out," sixteen candle-power or nothing. The time in the century arrived for something better and with it came the HYLO baby filament lamp.

It is sufficient now that some electric lamps are turned down, one, or at most two, in each room, but the ever-expanding standard of good practice will in time decree that every electric light shall be fixed so it can be turned down whether it is often turned down or not.

Hitherto the problems before the central-station manager have been largely those of generating and distributing electricity, but for the future the manager will be obliged more and more to study the best uses of the current on the premises of the consumer. Electric light holds its place solely on account of convenience—never on account of price. It can never compete in cost. All the small devices by which the convenience and utility of electric light is increased are, therefore, of great importance and of increasing benefit to the station. The HYLO lamp is a good thing for the current-seller as well as for the current-user. It is the most important addition which has been made to the convenience of electric light.

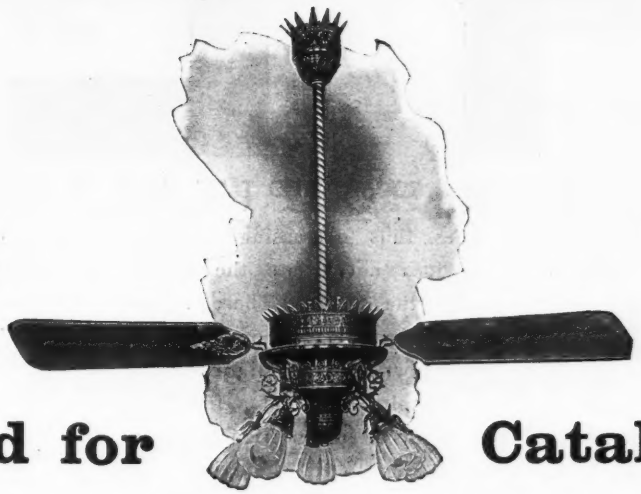
Two cases of this kind have actually been brought to our attention. In one town the use of HYLO lamps is forbidden, and in another consumers are charged 25 cents per month flat in addition to meter readings for each and every HYLO lamp in use. What a whacking good magazine ad this will make. Who says they don't save current now?

THE PHELPS CO., 29 Rowland St., DETROIT, MICH., U. S. A.

Other HYLO ads on pages 1, 4, 7, 9, 10, 13, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 42, 47, 48, 51 and 52.

THE LARGEST SELECTION

DESK
BRACKET
CEILING
VENTILATING
AND BATTERY
FAN OUTFITS



FOR
DIRECT
AND
ALTERNATING
CURRENTS
ALL VOLTAGES

Send for Catalogue

OKONITE IT NEVER DISAPPOINTS

Central Electric Company,

264-266-268-270 FIFTH AVENUE, CHICAGO

OKONITE IT NEVER DISAPPOINTS

FANS
FANS
FANS

THE FINEST BREEZE PRODUCERS IN THE WORLD

The Colonial Fan

DIRECT CURRENT, CEILING OR DESK. GIVE US A TRIAL ORDER. THEY ARE THE BEST MADE FOR THE MONEY. LARGE STOCK. LOW PRICES. PROMPT SHIPMENT.

St. Louis Electrical Supply Co.

1118 Pine Street St. Louis, Mo.

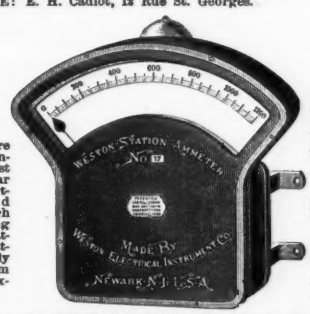
WESTON Electrical Instrument Co.

Waverly Park, Newark, N. J., U. S. A.

BERLIN: European Weston Electrical Instrument Co., No. 88 Ritterstrasse.
LONDON: Elliott Bros., No. 101 St. Martin's Lane.
PARIS, FRANCE: E. H. Cadiot, 12 Rue St. Georges.

ILLUMINATED DIAL, STATION INSTRUMENTS

These instruments are based upon the same general principle and are just as accurate as our regular Standard Portable Direct-Current Voltmeters and Ammeters, but are much larger and the working parts are enclosed in a neatly designed, dust-proof, cast-iron case which effectively shields the instruments from disturbing influences of external magnetic fields.



WESTON STANDARD

Portable, Direct Reading Voltmeters and Millivoltmeters. Ammeters and Milammeters, Wattmeters and Voltmeters, for Alternating and Direct-Current Circuits.

Our portable instruments are recognized as standards throughout the civilized world.

Our Semi-Portable Laboratory Standard Voltmeters and Ammeters are still better.

They are the most reliable, absolute standards for Laboratory use.

Weston Standard Illuminated Dial Station Ammeter, Style B.

TRADE MARK

Railway Regulating and Sub-Station Plants
Lighting, Power and Isolated Plants

COMPLETE EQUIPMENTS WITH THE GOULD PATENTED

COUNTER E. M. F. AND "EXCITER" } **BOOSTER SYSTEMS**

GOULD STORAGE BATTERY CO.

SALES OFFICES

BOSTON, 53 STATE ST. CHICAGO, ROOKERY BLDG. NEW YORK, 25 WEST 33D ST.

"FACTS ABOUT THE GOULD BATTERY" UPON APPLICATION

HYLO

FOR HOSPITALS

Electric light is the only safe and suitable light for hospitals and asylums. The HYLO lamp is the only proper lamp for the wards and halls of these institutions. The comfort of both patients and attendants requires a dim light, and many crude expedients have been used to secure it in the past. The HYLO satisfies every condition perfectly.

It makes no smoke; requires no matches, thus decreasing the fire risk; does not vitiate the air or damage the walls. There is no danger of asphyxiation or water-gas poisoning when electric light is used. Every hospital has had a few fires from cloth or paper tied about a common lamp to dim the light. The HYLO removes that risk entirely. It takes only one-sixth as much current as a common lamp and makes light enough to read a fever thermometer, or give a dose of medicine.

The ½–8 candle-power lamp takes only one-tenth as much current as a common lamp and makes light enough for the bedroom. The two filaments of the HYLO have a combined life of 4,000 hours. In a hospital the full life is realized. The HYLO will reduce your lamp expense. It will cost less than a common lamp.

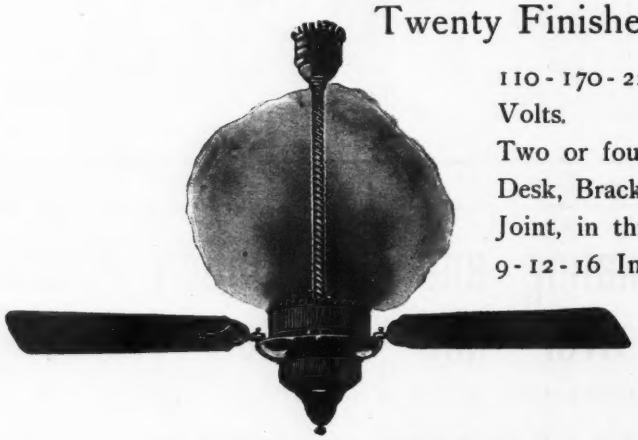
Sample on receipt of 75 cents.

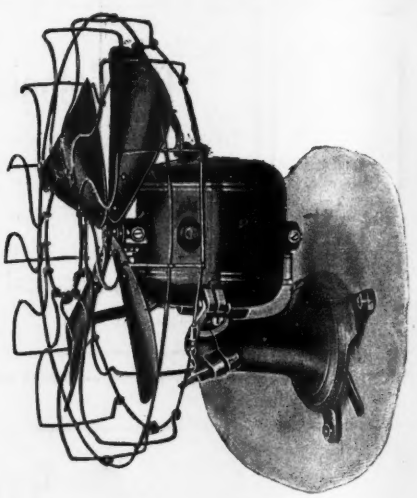
THE PHELPS CO., 29 ROWLAND ST., DETROIT, MICH., U. S. A.

Other HYLO ads on pages 1, 2, 7, 9, 10, 13, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

DIEHL ELECTRIC FANS

Two Types of Ceiling
Twelve Designs of Ceiling
Twenty Finishes of Ceiling





110 - 170 - 220 - 250 and 500 Volts.
Two or four Blades.
Desk, Bracket, or Universal Joint, in three sizes.
9 - 12 - 16 Inch.

Making the largest line of Fans ever offered and our 14 years' experience assures you that they are the Best

DIEHL MANUFACTURING CO.

MAIN OFFICE AND WORKS
ELIZABETHPORT, NEW JERSEY

SALES OFFICES

561-563 Broadway,	New York City
128-132 Essex Street,	Boston
1217 Filbert Street,	Philadelphia
Central Electric Co.,	Chicago
Newman-Sprahley Co.,	New Orleans
Waco El. Supply Co.,	Waco, Texas

(3)

TIME FOR ACTION

Now is the time to put lighting plants in the best possible condition. In your specifications for new apparatus and improvements don't forget to include

COLUMBIA CARBONS

Let us tell you how you can begin their use without taking a single chance

NATIONAL CARBON COMPANY CLEVELAND OHIO

THE CONSOLIDATED "AXLE LIGHT" SYSTEM OF

Electric Lights and Fans

FOR ALL KINDS OF RAILWAY PASSENGER CARS

☞ Adopted as the electric lighting system on Pullman Private Cars

By this system Electricity for the lighting of railway cars is generated by means of a Dynamo driven by the Axle while the car is in motion, and is supplied automatically from storage batteries when the car is stationary.

Each car carries its own electric lighting apparatus, being entirely independent of all other cars or of any charging plant.

Electric lights and fans keep a car bright and well ventilated.

The system has been demonstrated to be efficient, economical and—above all—Safe; and has come to stay.

CONSOLIDATED RAILWAY ELECTRIC LIGHTING AND EQUIPMENT COMPANY

100 BROADWAY NEW YORK

J. L. WATSON, Secretary and Treasurer
JNO. T. DICKINSON, General Agent, N.Y.
GEO. W. CARHART, General Agent,
83 West Jackson Blvd., Chicago, Ill.

F. N. Abbott
Vice-Pres't and Gen'l Manager

CONSTANT-CURRENT SERIES LONG-BURNING ARC LAMP

WRITE FOR BULLETINS

DIRECT CURRENT

Arc Lamps

SERIES ALTERNATING

Nos. 7008-7011

WESTERN ELECTRIC COMPANY

CHICAGO NEW YORK
SAINT LOUIS PHILADELPHIA

THE STANDARD FANS

Circular No. 22—Desk and Bracket Fans
Circula No. 23—Style "A" Ceiling Fan
Circula No. 24—Style "B" Ceiling Fan
Circular No. 25—500-Volt "Special" Ceiling Fan

THE ROBBINS & MYERS CO.

For all D. C. Circuits
For Quick Delivery
For Good Taste

Main Offices and Works SPRINGFIELD, OHIO
Eastern Sales Dept., 136 Liberty St., N. Y. City

Have YOU Seen It?
IF NOT
ORDER SAMPLE FAN
NOW
Every Dealer MUST Have It

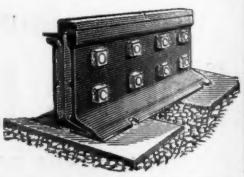
The "Comfort OSCILLATING Electric Fan"
MANUFACTURED BY
The Shedd Electric and Manufacturing Co.
136 Liberty Street
NEW YORK
Patented in U. S. and Foreign Countries

A Breeze and Light
for the same price. The new
PACIFIC FAN-LAMP
for direct current only.
Keep cool and have a good light on your work.
Send for circulars and price. . . . .
Pacific Electric Company
La Crosse, Wis.

READ
STERLING SPECIAL
ads in other issues

COMPLETE SUBWAY SYSTEMS
BUILT FOR ALL PURPOSES
G. M. GEST, Expert Subway Contractor
CINCINNATI, OHIO 277 BROADWAY, N. Y.

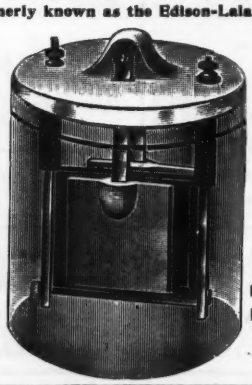
Continuous Rail Joint Co. of America.
General Offices, Century Building,
142 Market Street, Newark, N. J.



OVER TEN THOUSAND MILES IN USE.

Tuerk Alternating Current CEILING FANS
General and Export Agents HUNTER FAN AND MOTOR CO. Western Agents
E. B. LATHAM & CO. 39 Vesey St., New York
FULTON, N. Y.
WESTERN ELECTRIC CO. CHICAGO AND ST. LOUIS

EDISON PRIMARY BATTERIES
Formerly known as the Edison-Lalande.



FOR GAS ENGINES,
SLOT MACHINES,
AUTOMOBILES,
RAILROAD SIGNALS,
CROSSING BELLS,
SMALL MOTORS,
ETC. . . .

CONSTANT CURRENT
NO LOCAL ACTION,
WILL NOT FREEZE.
LIQUID TIGHT
CELLS FOR PORTABLE WORK
Full Description in Booklet No. 17.

EDISON MANUFACTURING COMPANY.
Factory, Orange, New Jersey, U. S. A. New York Office, 83 Chambers Street.
Chicago Office, 144 Wabash Avenue.

Bicycles Below Cost

5000 Bicycles, *overstock*. For 30 days only we will sacrifice at *less than actual factory cost* New 1902 Models.
"Bellise," complete $8.75
"Cossack," Guaranteed High Grade $9.75
"Siberian," a Beauty $10.75
"Neudorf," Road Racer, $11.75
no finer bicycle at any price.
Choice of M. & W. or Record tires and best equipment on all our bicycles. *Strongest guarantee.*
We SHIP ON APPROVAL C.O.D. to anyone *without a cent deposit* & allow 10 DAYS FREE TRIAL before purchase is binding.
500 good 2nd-hand wheels $3 to $8.
Do not buy a bicycle until you have written for our free catalogues with large photographic engravings and full descriptions.
MEAD CYCLE CO. Dept. 388 N Chicago.

In making advertising copy do not condense ideas—rather condense words

HYLO

FOR HOTELS

The HYLO lamp is an article of luxury which every first-class hotel will be obliged to provide for its guests, as essential as steam heat, push-buttons or electric light itself. Your guests, Mr. Landlord, will not turn down the light to save your coal pile or your meter bills, but they will turn down the light for comfort. Forty per cent of the men who register with you have brought up babies and have acquired the habit of sleeping with a light in the room.

We demonstrate to you that the two filaments of the HYLO will last as long as three common lamps and therefore that your lamp expense will not be increased. You get this improvement for your house without, practically, expense.

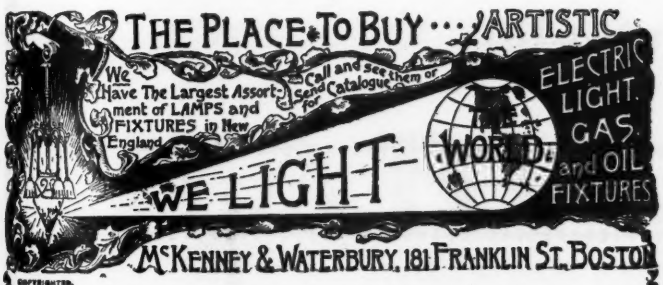
But if you should take the most billious view of it and assume that the HYLO is never turned down but is burned out like a common lamp, do you know that the extra cost would be only 3 cents per room per month. If the HYLO pleases even a few of your guests at that price (mind, we insist there will be no extra cost) you cannot afford to be without it.

In halls and bathrooms, where lamps are under the control of your employés, you get much better distribution after 12 o'clock and save much current. The saving of current in halls alone will pay for all the HYLO lamps you need in three or four months' time.

Write us how many lamps you have in halls? how many guest rooms? how many bathrooms and we will send you the cold figures.

THE PHELPS CO., 29 ROWLAND ST., DETROIT, MICH., U. S. A.

Other HYLO ads on pages 1, 2, 4, 9, 10, 13, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.


THE PLACE TO BUY ARTISTIC
We Have The Largest Assortment of LAMPS and FIXTURES in New England
Call and see them or send for Catalogue
ELECTRIC LIGHT GAS and OIL FIXTURES
WE LIGHT THE WORLD
McKENNEY & WATERBURY, 181 FRANKLIN ST. BOSTON
COPYRIGHTED.

We are Manufacturers and Retailers of Medium and Fine Grade :: :: :: :: ::

FIXTURES

FOR

LIGHTING

with ELECTRICITY, KEROSENE, GAS OR ACETYLENE.

Correspondence Solicited. *Send for Catalogue.*

Remember our address **181 Franklin St., Boston**

Buy the Standard
Brookfield Screw-Glass Insulators

We are especially equipped for

HIGH POTENTIAL POWER TRANSMISSION WORK

Write us for prices.
Send us designs for estimates.

THE BROOKFIELD GLASS CO.

218-220 Broadway, New York

Works: Brooklyn Borough

Cotton tape carries from 5 to 10 per cent of water into armature windings. This must be baked out and replaced with insulating compound, a process which deserves careful "cost study."

ARMALAC tapes cost less than old-style tapes and contain no moisture.

With our patent aluminum bobbins the cost of hand winding is enormously decreased. Field coil work shows an unusual saving.

SAMPLES ARE TO BE HAD
FOR THE ASKING

Address all inquiries "INSULATION DEPT."

Massachusetts Chemical Co.

170 Summer Street, BOSTON, MASS., U. S. A.

Insulation Plant and Rubber Works, Walpole, Mass.

Authorized Agencies carrying Stock of Genuine Goods:

W. R. GARTON CO.
118 Jackson Boulevard
CHICAGO, ILL.

ELECTRIC RAILWAY & MFG. SUPPLY CO.
68-72 First St.
SAN FRANCISCO, CAL.

ST. LOUIS ELECTRICAL SUPPLY CO.
1118 Pine Street
ST. LOUIS, MO.

J. H. ASHBY
Hennen Building
NEW ORLEANS, LA.

AMERICAN GENERAL TRADING CO.
136 Liberty St. and 139 Cedar St.
NEW YORK

JAS. CLARK, Jr. & CO.
315 West Main Street
LOUISVILLE, KY.

F. J. DOWN
Harpenden, Herts
ENGLAND

PHILIPP MUHSAM
Alexandrinenstrasse 11
BERLIN, GERMANY

PERSICANER & CO.
VIENNA and BUDAPEST

VICTOR DOURIN
28 Rue de la Montagne
BRUSSELS

HYLO

The only successful turn-down lamp—more than half a million users—all of them satisfied—all our friends.

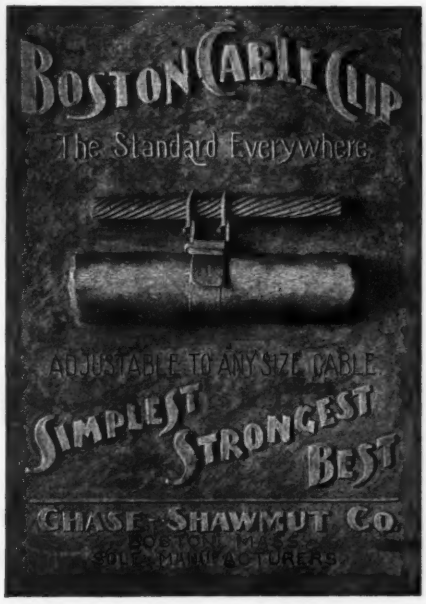
Ask any one of them about the HYLO.

If your electrician will not supply you promptly, don't wait; send us 75 cents for sample by mail. Circular free on request.

The Phelps Company

29 Rowland St. Detroit, Mich., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 10, 13, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.



New York Representative
WILLIAM S. BROWN
39 Cortlandt Street

HABIRSHAW

WIRES AND CABLES REPRESENT HIGHEST INSULATION

After you have considered all the other factors in electrical construction then weigh well the one of **insulation.** This is accomplished to the highest degree by the **HABIRSHAW PRODUCTS.**

HABIRSHAW means the best in india-rubber insulation. We are the authorized manufacturers of **ATTIX FLEXIBLE TUBE WIRE.**

The India-Rubber and Gutta-Percha Insulating Co.

Main Office, Glenwood Works

YONKERS, N. Y.

SALES OFFICE
15 Cortlandt Street, New York

HYLO

The only turn-down lamp anybody ever buys again.

THE PHELPS COMPANY, - - - - - - - 29 Rowland Street, Detroit, Mich., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 9, 13, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

NATIONAL ELECTRICAL CODE STANDARD

IXL Weather-Proof
Slow Burning Weather-Proof
Slow Burning Wire

PRICES AND SAMPLES ON APPLICATION

COLLYER INSULATED WIRE AND CABLE CO. PAWTUCKET R. I.

RUBBER COVERED WIRES AND CABLES

SAFETY

FOR EVERY SERVICE.

For Underground, Aerial and Submarine use, "SAFETY" wires and cables have the indorsement of some of the largest users in the United States. Write for our booklet containing the experience of users.

The Safety Insulated Wire & Cable Co.
225 TO 239 WEST 28TH STREET,
NEW YORK.

H. N. FENNER President J. F. BLAUVELT, Agent RUSSELL W. KNIGHT, Treasurer

NEW ENGLAND BUTT COMPANY

MANUFACTURERS OF

MACHINERY for INSULATING ELECTRICAL WIRES

Braiding, Taping, Winding, Twinning, Cabling, Stranding, Polishing and Measuring Machines. Cable Covering Braiders

FINE CASTINGS A SPECIALTY

304 PEARL STREET, - - - PROVIDENCE, R. I., U. S. A.

"AMERICAN"

ELECTRIC WIRE CONDUITS, COUPLINGS, ELBOWS, ETC. ENAMELED INSIDE AND OUTSIDE

Ferrotype Plates, Developing Trays Japanned Sign Plates Lacquered Tin, Etc.

Pittsburg Freight Rates

AMERICAN CONDUIT MFG. CO. NEW KENSINGTON, PA.

HAZARD MANUFACTURING CO., WILKESBARRE PA.

HIGH-GRADE RUBBER-COVERED WEATHERPROOF WIRES and CABLES.

Magnet, Office, Annunciator Wire.

NEW YORK OFFICE, 50 DEY STREET. CHICAGO OFFICE, 1201 MARQUETTE BUILDING.

SHELBY LAMPS SHELBY, OHIO.

The "CLARK" Wire

FOR SWITCHBOARD, RAILWAY AND MOTOR USE.

All sizes of stranded and flexible wire and cables with Clark's insulation.

Inspector Boston Fire Underwriters' Union says:—"A thoroughly reliable and durable wire in every respect."

The Clark wire has been before the public, and in use, for the past 10 years and has met with universal favor. We guarantee our insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

Eastern Electric Cable Company,
61-63 HAMPSHIRE STREET, BOSTON, MASS.
Henry A. Clark, Treas. and Gen. Manager. Herbert H. Eustis, Prest. and Electrician.

STANLEY & PATTERSON

(INCORPORATED)

Manufacturers of General Electrical Equipment Supplies

93 LIBERTY ST.

DEVEAU TELEPHONE APPARATUS

Branch—32 & 34 FRANKFORT ST.—Store
Uptown—329 FOURTH AVE.—Store
FACTORY, 27 ROSE STREET

NEW YORK

In the Electrical Field "trouble" and "poor material" are synonymous terms, so that when Electricians complain of "trouble" with insulated wires and cables, it is a sure sign they are not using

"OKONITE,"

the standard for rubber insulation which has no equal.

Candee wires and potheads, Okonite and Manson Tapes are the very best to be obtained.

Prices and further information cheerfully furnished

The Okonite Company, Ltd.

253 Broadway, New York

OKONITE
TRADE MARK.

Willard L. Candee
H. Durant Cheever
} Managers

OKONITE
TRADE MARK.

THE GENERAL ELECTRIC COMPANY'S

New Interchangeable Type Arc Lamps

Enclosed Arc for Direct Current
110-Volt Circuits

Enclosed Arc for Alternating Current
110-Volt Circuits

Enclosed Arc for Direct Current
220-Volt Circuits

"The Station Man's Lamp"

GENERAL OFFICE, SCHENECTADY, N. Y.

Sales Offices in all Large Cities — New York Office, 44 Broad Street

CLOCKS

With Electrical Devices of all kinds are our specialty. We also make Time Switches for turning out electric lights, Program Clocks for ringing bells, Synchronized Clocks for uniform time, 60-Day, Calendar and Frying-Pan Clocks.

Send for Catalogue No. 202

The Prentiss Clock Improvement Co.
Dept. 20, 49 Dey St., New York City

We are the original patentees and sole manufacturers of genuine lava insulation. Our new name and trade-mark is

Lavite

to distinguish the genuine from imitation. It is broadly protected. Refuse substitutes.

The D. M. Steward Mfg. Co.
Chattanooga, Tenn.
New York Office
107 Chambers Street

THE PRACTICAL, ACTIVE, THINKING, PROGRESSIVE, BUYING MEN are close readers of the ELECTRICAL REVIEW. . . . .

CHICAGO EDISON COMPANY

REPAIR SHOPS

76 MARKET STREET, CHICAGO. Telephone, Main 1280

FIRST-CLASS EQUIPMENT IN ALL SHOPS

OPEN DAY and NIGHT . . PROMPT ATTENTION

Dynamos, Armatures, Motors, Arc Lamps, Instruments, Machine Shop; Engines, Etc., Carpenter Shops; Cabinets, Etc.

CORRESPONDENCE SOLICITED

THE ELECTRICAL REVIEW

prints more telephone articles and telephone news items than any other paper published

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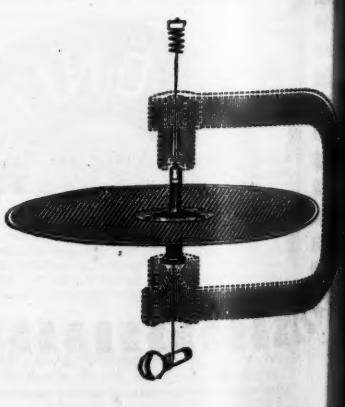
THE IMPORTANCE OF MAGNETICALLY FLOATING THE MOVING PARTS OF A METER?

Send for description and book full of good information "ABOUT METERS"

STANLEY INSTRUMENT COMPANY

General Sales Office, 156 Broadway, New York, N. Y.
Pacific Coast Agency, 33 New Montgomery Street, San Francisco, Cal.



WE ARE PREPARED TO FURNISH

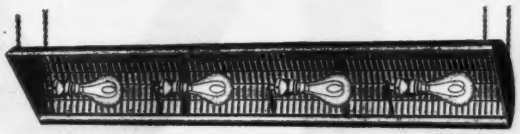
KNIFE SWITCHES

Arranged for all standard makes of Enclosed Fuses

We have all styles and sizes of Clips for Enclosed Fuses IN STOCK. Send us your order for

SWITCHES, PANEL and SWITCHBOARDS

W. S. HILL ELECTRIC COMPANY
NEW BEDFORD, MASS.



THE ONLY WAY

To light a window or picture satisfactorily is by using a Wheeler No. 85 Window Reflector . . . . . .
It is well made, finely finished and price is not high .
Write us stating your requirements and we will quote

WHEELER REFLECTOR CO.
100 PURCHASE STREET, BOSTON
Foreign Department, 88 Maiden Lane, New York City

HYLO

The only good-looking turn-down lamp. The graceful HYLO filament needs no concealment behind frosting.

Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

The "Chloride Accumulator" for Central Stations, Electric Railways, Isolated Lighting and Power Stations, Fire Alarm and Telegraph Service, Train Lighting, Laboratory, etc.

The "Exide Accumulator" for Electric Vehicles.

PRICE LISTS AND DESCRIPTIVE BULLETINS FORWARDED UPON REQUEST.

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Allegheny Ave. & 19th St.	100 Broadway	60 State Street	Marquette Bldg.	Equitable Bldg.	Wainwright Bldg.	Nevada Block	New England Bldg.	Michigan Electric Co.	G. F. Greenwood, Manager, 34 Empedrado Street

SCIENCE ABSTRACTS, PHYSICS AND ELECTRICAL ENGINEERING

PUBLISHED MONTHLY

Issued under the direction of the INSTITUTION OF ELECTRICAL ENGINEERS and the PHYSICAL SOCIETY OF LONDON

A most invaluable publication. Its name sufficiently implies its scope and purport. Its abstractors, some sixty odd, are necessarily leading experts in the branches they undertake.

SCIENCE ABSTRACTS has a wide and influential circulation. It is officially taken by all the members of the above-named societies, and has a strong outside circulation by subscription and otherwise.
It follows that it is an excellent advertising medium. Advertising space is limited. All particulars from the Publishers and Advertising Contractors.

The FEILDEN PUBLISHING CO., Ltd., Temple Chambers, London, E. C.

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FOR STEAMSHIPS

Our ½–8 candle-power lamp is especially suited to the state-rooms of ocean and lake steamers. Passengers will not turn down the light to be kind to the engineer, but they will turn down the HYLO for their own comfort.

In the saloon the effect of many HYLOs turned down is much more artistic than a few 16 candle-power lamps. Wherever on the boat lights are under the control of employés the saving in current is considerable.

The two filaments of the HYLO wear so long that it really costs no more in the end than a common lamp.

Timid women and old people who want a night light will appreciate the HYLO when two strangers occupy the same state-room; the first man to "turn in" can leave an undressing light for his roommate without incommoding himself. The ½ candle-power HYLO makes light enough for all seaside purposes. Samples sent by mail on receipt of 75 cents.

THE PHELPS COMPANY, 29 Rowland St., Detroit, Mich., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 17, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

ELECTRICAL MECHANICAL CONSULTING

DIRECTORY OF ENGINEERS

CONTRACTO SPECIAL INTERESTS

ARNOLD ELECTRIC POWER STATION COMPANY,
ENGINEERS, CONTRACTORS.
For Complete Electric Plants. Results Guaranteed.
SUITE, 1539 MARQUETTE BLDG., CHICAGO.
New York Office, 711 Transit Building.

GEO. T. HANCHETT,
CONSULTING AND ELECTRICAL ENGINEER,
114–116 NASSAU ST., NEW YORK.

New England Engineering Co.
100 BROADWAY, NEW YORK. WATERBURY, CONN.
Electric Railways, Electric Light and Power Plants, Gas and Water-works, or any other engineering installations built or remodeled.

SHEAFF & JAASTAD,
MECHANICAL and ELECTRICAL ENGINEER
Plans and specifications for superintendence of Electric Power Lighting Plants a specialty.
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F. B. BADT & CO.,
CONSULTING ENGINEERS AND EXPERTS.
Telephone Harrison 745
1504 MONADNOCK CHICAGO

L. W. KUTSCH,
SWITCHBOARDS IN MARBLE AND SLATE, FOR LIGHT AND POWER . . .
GENERAL ELECTRICAL CONSTRUCTION
1728-1729 Monadnock Bldg., CHICAGO

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CENTRAL STATION STREET RAILWAY DIRECTORIES.
Complete, up-to-date manuals for Financial, Official, Electrical and Mechanical Reference.
THE E. L. POWERS CO., PUBLISHERS,
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J. H. VAIL,
Mechanical and Electrical Engine
Rooms 715-18 Hale Building,
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Plans, specifications, contracts, ports. Twenty years' practical exp ence. Electric lighting. Railw Power transmission.

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Plans and Supervision of Installation of Complete Lighting, Power and Railway Plants. Special Reports on Electrical Properties.
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Long Distance Power Transmission and Alternating Current Problems a Specialty.
PARK ROW BUILDING, NEW YORK.

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Designs, Specifications, Estimates, Valuations, Tests and Expert Work. Electric Railways, Lighting and Power Transmissions Steam and Hydraulic Work.

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29 Broadway, New York, N. Y.
LONDON CORRESPONDENTS:
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22A COLLEGE HILL, CANNON STRE

JAMES BLAKE CAHOON,
CONSULTING GAS AND ELECTRICAL ENGINEER,
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Properties bought. Opinions and Advice on Consolidations and Re-organizations of Properties.

THOS. J. McTIGHE, Consulting Engineer.
Mechanical, Electrical, Mining, Reports, Estimates, Supervision, Inventions.
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13-21 PARK ROW, NEW YORK.

ARVID REUTERDAHL,
CONSULTING STORAGE BATTERY ENGINEER.
67-69-71 FOUNTAIN STREET,
PROVIDENCE, R. I.

C. H. WILMERDING,
CONSULTING ENGINEER,
184 LA SALLE STREET, CHICA
Design and Construction of Electr Lighting and Power Plants. Electri Equipment of Mills, Factories a Shops. Underground Distributi Systems, Estimates, Reports.

KEYSTONE MEASURING INSTRUMENTS

A COMPLETE LINE OF HIGH-GRADE PORTABLE AND SWITCHBOARD INSTRUMENTS. THE KEYSTONE IS THE STANDARD OF THE FUTURE. WE WILL NOT SELL AN INSTRUMENT THAT WE CANNOT GUARANTEE. LET US SEND YOU SOME LITERATURE ON THE SUBJECT:::

THE CUTTER CO.
19th and Hamilton Sts.
PHILADELPHIA

...TER & BERG, 309 Dearborn Street, Chicago
...E. CROFOOT, 234 W. 14th Street, Cincinnati
T. H. BIBBER & CO., 37 Arch Street, Boston
G. A. ANNABLE, 120 Liberty Street, New York
JOHN R. COLE, 33 Second Street, San Francisco
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RHEOSTATS AND ELECTRIC CONTROLLING DEVICES OF EVERY DESCRIPTION.

THE CUTLER-HAMMER MFG. CO.

AGENTS:
...ERANT ENGINEERING CO., LONDON, ENG.
...E & EDGE SYDNEY, N. S. W.
...OURNE & CLARK CO., SEATTLE, WASH.

MAIN OFFICES AND FACTORY, MILWAUKEE. BRANCH OFFICES NEW YORK-CHICAGO.

...ICTOR SOLDERING STICK.

THE STANDARD FOR ELECTRICAL USE.

For making a sound, quick and durable joint it stands absolutely without a ... *It will not splutter nor corrode.*
Each stick has a close-fitting pasteboard tube over the tin-foil, preserving its ... and making it the cleanest and easiest handled soldering flux in existence.
Buy from your regular supply house or write us. Samples free.

...NOR CHEMICAL COMPANY, 541 Gates Ave., Brooklyn, N. Y.

Entirely Satisfactory

The Cumberland Telephone and Telegraph Co., Nashville, Tenn., write:—"*Replying to yours of the 14th inst. with reference to Leeds Portable Testing Set would say that we are pleased to advise you that this set is entirely satisfactory.*"

It is real economy to any Telephone Exchange to have a Leeds Set on hand for testing lines, locating faults, etc. Catalogue free on request.

JAMES G. BIDDLE
Stephen Girard Bldg., Philadelphia

...HARTFORD" ROSETTES

"CONCEALED."

FOR CLEAT, CONCEALED AND MOULDING WORK.

Approved by the UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

Cap and bases interchangeable.

Positive lock and sure contact.

Cap can not be loosened or contact lessened by shaking or pulling on the cord.

...E HART MFG. CO., HARTFORD, CONN.....

Voltmeters, Ammeters, and Volt-Ammeters . . .

POCKET SIZE, VARIOUS RANGES, ACCURATE, RELIABLE.

For General Measurements, Testing Storage and Primary Batteries, Circuits, Etc.

L. M. PIGNOLET,
Manufacturer of ELECTRIC INSTRUMENTS, and ELECTROTHERAPEUTIC APPARATUS.
78 Cortlandt Street, New York.

STEEL OUTLET AND JUNCTION BOXES

Switchboards, Panel Boards, Switches, Etc.

..MADE BY..

THE BOSSERT ELECTRIC CONSTRUCTION CO.
UTICA, N. Y.

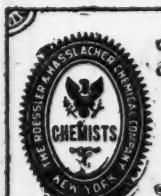
SCOTT & WILLIAMS
2079 E. CUMBERLAND ST.
PHILADELPHIA, U.S.A.

MANUFGR'S OF MILLED MACHINE SCREWS.

...E REUTERDAHL STORAGE BATTERY

OUR
Electrochemically Formed Plate
IS CONSTRUCTED IN ACCORDANCE WITH THE MOST ADVANCED IDEAS OF MODERN ELECTROCHEMISTRY
WRITE FOR BULLETIN G

...UTERDAHL ELECTRIC CO. PROVIDENCE-R.I.
...TERN OFFICE. 1504 MONADNOCK BLOCK. CHICAGO ILL.



"BATTERY BRAND"
SAL AMMONIAC.
WE SOLICIT YOUR INQUIRIES
CHLORIDE OF ZINC.
FUSED AND GRANULAR.
The Roessler & Hasslacher Chemical Company,
100 WILLIAM ST. NEW YORK.

Electrical Catalogue

The Most Complete Ever Issued

You will notice that it is made up in Bulletin Form for the convenience of our customers.

Each class of material is contained in a separate Bulletin.

The set, bound in handsome cloth covers, is a complete catalogue of

GENERAL ELECTRICAL SUPPLIES

We also issue several other Bulletins, including one on line and construction material, one on a complete assortment of high-tension porcelain and glass insulators, one on electric gas-lighting supplies and house goods, and one on Fan Motors for 1902.

FROM TIME TO TIME WE SHALL PUBLISH NEW BULLETINS TO TAKE THE PLACE OF THOSE THAT HAVE BECOME OUT OF DATE OR WHERE THE MATERIAL HAS CHANGED. THUS OUR CUSTOMERS WILL ALWAYS HAVE A COMPLETE UP-TO-DATE CATALOGUE OF ELECTRICAL SUPPLIES AT THEIR COMMAND.

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

Sole New England Agents

OKONITE

WIRES and CABLES

Pettingell Andrews Co.

The Leading Supply House

BOSTON, MASS.

"PHONO-ELECTRIC" WIRE

For PERMANENT

PERFECT

SERVICE

The Little Book

We have recently caused to be printed gives much interesting data on the sound-carrying

capacity of line wire. The facts given are based on technical tests.

Send for it.

"Phono-Electric" Wire combines high tensile strength, high elastic limit and great toughness with remarkable wearing qualities.

BRIDGEPORT BRASS CO.

19 Murray Street

New York

Mills: Bridgeport, Conn.

HYLO

THE ONLY SUCCESSFUL TURN-DOWN LAMP

Exclusive manufacturers under license for Canada and British North America

THE PACKARD ELECTRIC CO.

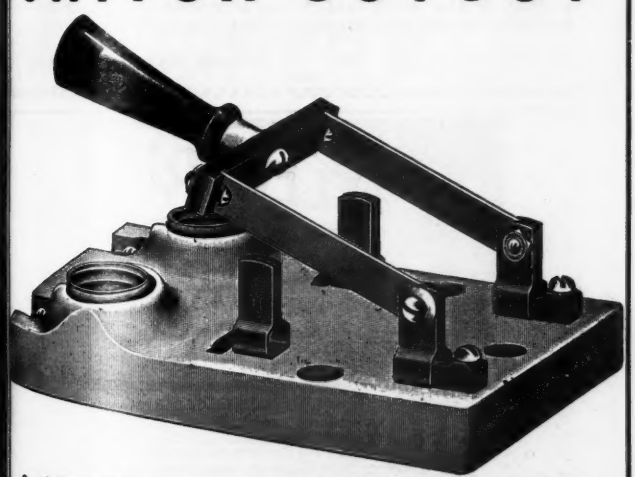
ST. CATHARINES, ONTARIO, CANADA

Makers of Packard Incandescent Lamps, Packard Transformers and Diamond Meters
Address all Canadian correspondence as above

The Phelps Co., 29 Rowland Street, Detroit, Mich., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 14, 19, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

COMBINATION SWITCH CUTOUT



Specially adapted for entrance switch and fulfills the National Board of Fire Underwriters' specifications for this work

MADE IN 2 AND 3 WIRE BY

THE NEW ENGLAND ENGINEERING CO.

WATERBURY, CONN.

Write for Prices

—SPECIAL—

READY FOR SHIPMENT NOW | 1—75-Lt., 2—45-Lt., 2—40-Lt., 1—35-Lt. T. H. Arc Machines. 3—A30 Old Style T. H. Alternators, 1040 V. In good condition. Very cheap.

"THE HART" RECTANGULAR BASE FLUSH SWITCH

is narrow enough to fit iron wall frames and boxes designed for "H. & H." Push Switches and is the same in mechanism as the regular "Hart" Rotary Switch.

Hart Rotary and "H. & H." Push Switches

in all types. Ask for a Catalogue.

THE HART AND HEGEMAN MFG. CO.

92 UNION PLACE, HARTFORD, CONN.

(5)

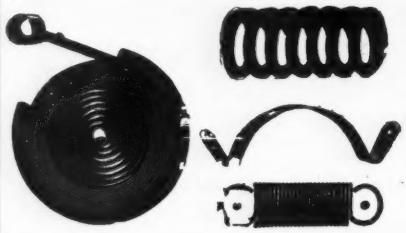
SIEGRIST SYSTEM,

AUTOMATIC LUBRICATION—PATENTED

THE GREAT OIL AND LABOR SAVER. PAYS A BIG INTEREST ON THE INVESTMENT.
NOT AFFECTED BY HEAT OR COLD. PLENTY OF OIL UNDER ALL CONDITIONS.

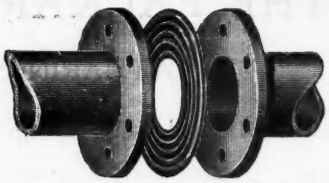
OWNERS AND CONSULTING ENGINEERS ARE INSTALLING IT ALL OVER THE WORLD.

A LIST OF USERS FURNISHED BY ADDRESSING **SIEGRIST LUBRICATOR CO., ST. LOUIS, MO., U. S. A.**



Cary Spring Works
240 & 242 West 29th St.
NEW YORK CITY
Manufacturers of
Wire and Springs
For Machinery, Motors, Clocks, Music Boxes and all kinds of Electrical Purposes

Our... Patented **Mineral Wool Coverings and Copper Gaskets**



THEY SAVE STEAM AND MAKE ABSOLUTELY TIGHT JOINTS
U. S. MINERAL WOOL CO.
106 West St.
NEW YORK - - N. Y.

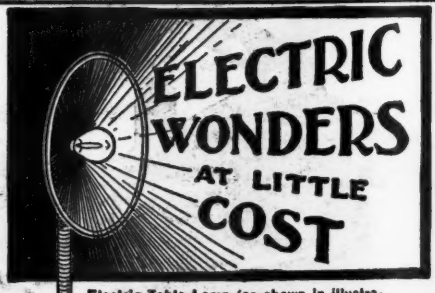
SPRINGS

(All the small springs used by electrical trade . . . . .)
THE WALLACE BARNES CO.
Bristol, Conn. Established 1857
Submit samples or specifications for quotations . . . . . .
ASK FOR CATALOGUE A A.

THE ELECTRICAL REVIEW
REACHES ELECTRIC LIGHT STREET RAILWAY AND TELEPHONE OFFICIALS WHO HAVE THE AUTHORITY TO BUY EQUIPMENTS.

IT PAYS TO GET THE BEST
EDWARD BONVILLE
Manufacturer of All Kinds of Slate for Electrical Purposes
BASES for KNIFE SWITCHES, DISTRIBUTING BOARDS and SWITCH-BOARDS in ALL SIZES. ALL KINDS of FINISHES in PLAIN and ENAMELED BLACK or MARBLEIZED. FINISHES in ALL FINE COLORS
P. O. LOCK BOX 24, - - FAIR HAVEN, VERMONT

Graphite Resistance.
Graphite Resistance in Rods, Tubes or otherwise. Any resistance wanted—one ohm to one million ohms. Write for particulars.
Joseph Dixon Crucible Co., Jersey City, N. J.



ELECTRIC WONDERS AT LITTLE COST

Electric Table Lamp (as shown in illustration) with Battery complete	3.00
Battery Hanging Lamp	10.00
Telephone, with Battery complete	5.05
Electric Door Bells, all connections	1.00
Electric Carriage Lamp	3.95
Fan Motor, with Battery	5.95
Electric Hand Lanterns	2.00
$8.00 Electric Medical Batteries	3.95
$12.00 Belt, with Suspensory	2.50
Telegraph Outfits, complete	2.25
Battery Motors from	$1.00 to 12.00
$6.00 Bicycle Electric Lights	2.75
Electric Railway	2.95
Pocket Flash Lights	1.50
Necktie Lights	.75 to 3.00

Send for Free Book. Describes and illustrates many of the most useful electric devices, at wonderfully small prices. All practical. The lowest price in the world on everything electrical. Agents can make handsome commissions and many sales. Write for complete information.
OHIO ELECTRIC WORKS, Cleveland, Ohio.

MODERN HEAT
"ELECTRICITY"
AMERICAN ELECTRICAL HEATER CO.
ELECTRIC HEATING APPLIANCES
195-197 RIVER ST. DETROIT, MICH. U.S.A.

The ELECTRICAL REVIEW
is quoted by the press of the country from eight to ten times more than any other electrical weekly published in America. This means that it is alive.

HYLO

Order HYLOs from your regular lamp-maker if you prefer, and have them counted on your F. D. contract the same as common sixteens. The following makers sell the HYLO at our regular prices :

Sunbeam Incandescent Lamp Co.
Sawyer–Man Electric Co.
Shelby Electric Co.
Fostoria Incandescent Lamp Co.
Bryan–Marsh Co.
Buckeye Electric Co.
Columbia Incandescent Lamp Co.

You sometimes save express charges by having HYLOs shipped with other lamps. Send your order to any of the above and notify us by postal card giving voltage and base to insure promptness.

THE PHELPS COMPANY, 29 Rowland Street, Detroit, Mich., U. S. A.

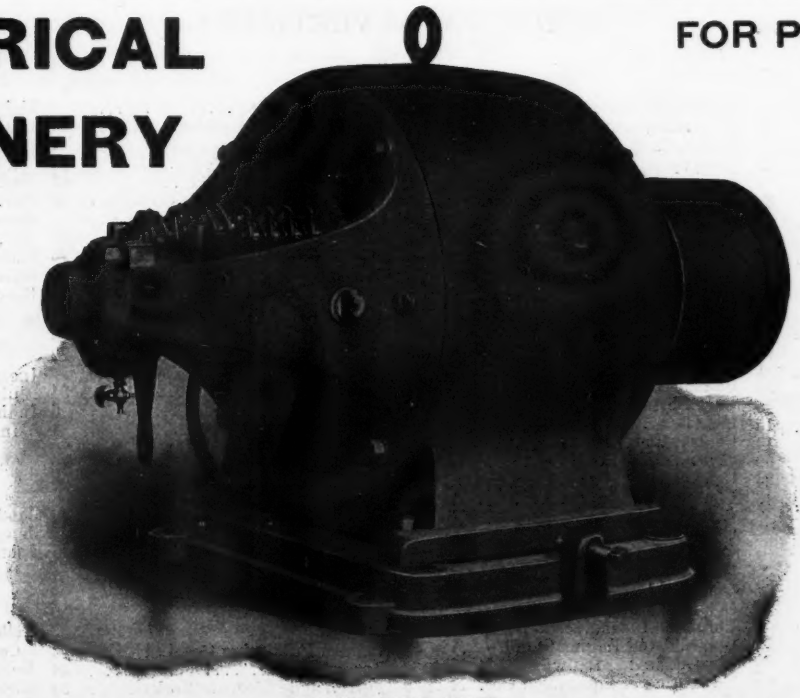
Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 14, 17, 21, 23, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

ELECTRICAL MACHINERY

FOR POWER AND LIGHTING

Milwaukee Type.

Browning Type.



We build a complete line of motors and generators from 1-12 h. p. to 500 k. w.

Special motors for cranes, printing presses and blowers.

Send for Bulletin No. 23.

BOSTON:
Chase-Shawmut Co.,
390 Atlantic Ave.

PHILADELPHIA, PA.:
D'Olier Engineering Co.,
125-127 S. Eleventh St.

MILWAUKEE TYPE.

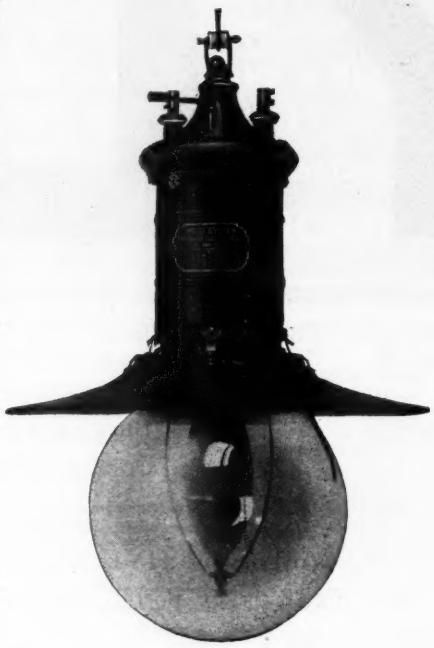
MILWAUKEE ELECTRIC CO.

MILWAUKEE, WIS., U. S. A.

NEW YORK OFFICE, 39 Cortlandt St.
MINNEAPOLIS OFFICE, 329 Hennepin Ave.
CHICAGO OFFICE, 1802 Fisher Bldg.
FOREIGN DEPARTMENT, 88 Maiden Lane, New York, N. Y.

FORT WAYNE ELECTRIC WORKS

SERIES ENCLOSED "WOOD" D. C. ARC LAMPS



MAIN OFFICE AND FACTORY FORT WAYNE, IND.

THE BEST LAMP ON THE MARKET

SALES OFFICES IN ALL LARGE CITIES

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HYLO

LIST OF LAMPS.

1-16 candle-power.—Made to fit Edison, T.-H. and Westinghouse sockets in any voltage from 50 to 125. Gives either 1 or 16 candle-power.

½-8 candle-power.—Made to fit Edison, T.-H. and Westinghouse sockets, any voltage, 100 to 120.

2-16 candle-power.—Made to fit Edison, T.-H. and Westinghouse sockets, 200 to 250 volts.

1-32 candle-power.—Made for Edison sockets only, any voltage, 100 to 120.

THE PHELPS COMPANY, 29 Rowland Street, Detroit, Mich., U. S. A.

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Mr. Otis H. Kean, the New York advertising expert, says:

"When you buy space you have only taken the first step. For what you put in that space—that is really the vital point—depends the value of that particular advertisement. Advertising is really a department of literature, and the same elements that cause a book to be read and talked about will cause an advertisement to be read and talked about. Of all the books written in the year but few remain with us. The rest are chaff and are soon forgotten. It is just so with advertising. How much of the great mass of matter that is written and printed is really worthy? The spirit of a concern should be represented by its advertising, and I believe that the public accept it in this light, and yet how much of the advertising sent out is inadequate both in conception and execution."

The Advertisement Department of the ELECTRICAL REVIEW appreciates fully the fact that the value to advertisers of its service is usually in proportion to the care given to the advertising copy. Frequent changes, often a little originality, good illustrations—these, taken together with a little courage on the part of the advertiser, sufficient to continue the advertisement for a period long enough to ripen the seed, always develop a permanent patronage.

When ordering an Automobile specify the **"Exide" Battery**

Exide Battery Depots for Furnishing, Charging and Caring for Exide Batteries

NEW YORK: 148 West 18th Street
CHICAGO: 264 Michigan Boulevard
BUFFALO: 200 Pearl Street
PHILADELPHIA: 250 North Broad Street
ST. LOUIS: 3937 Olive Street
Other Stations will be announced later

THE ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA

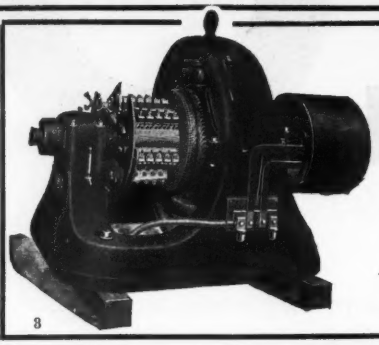
— SALES OFFICES —

PHILADELPHIA: Allegheny Ave. & 19th St.
NEW YORK: 100 Broadway
BOSTON: 60 State Street
CHICAGO: Marquette Bldg.
BALTIMORE: Continental Trust Bldg.
ST. LOUIS: Wainwright Bldg.
SAN FRANCISCO: Nevada Block
CLEVELAND: New England Bldg.
DETROIT: Michigan Electric Co. 101 Woodward Ave.
HAVANA CUBA: G. F. Greenwood, Manager 34 Empedrado Street

OUR DIRECT CONNECTED GENERATOR AND ENGINE IS THE STANDARD

The ELWELL-PARKER ELECTRIC CO. OF AMERICA

CLEVELAND, OHIO, U. S. A.



TRIUMPH GENERATORS AND MOTORS FOR LIGHTING and POWER

ALL SIZES—ALL TYPES—ALL APPLICATIONS
DIRECT-CONNECTED OR BELTED

SEND FOR BULLETIN "E. R."

TRIUMPH ELECTRIC CO., CINCINNATI, OHIO, U. S. A.

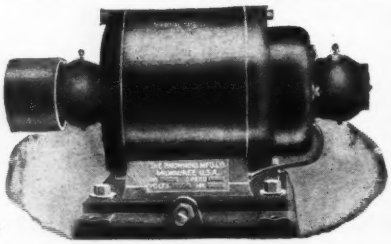
3

Electrical Machinery For Power and Lighting.

Milwaukee Electric Company,

Milwaukee, Wis. U. S. A.

DO YOU KNOW WHY THE BROWNING MOTOR is recognized as the Standard High Grade Motor of the World?



If not and you appreciate the BEST it will be to your advantage to investigate.

A Postal will bring the information.

Type K Bipolar Enclosed Browning Motor and Dynamo

Agencies in all principal cities

The Browning Mfg. Co. MILWAUKEE, WIS.

MOTORS GENERATORS

AKRON ELECTRICAL MFG. CO. AKRON, O.

OPEN OR ENCLOSED FOR POWER PURPOSES

BELTED OR CONNECTED DIRECT FOR LIGHTING PURPOSES

1 TO 600 HP 1 TO 500 KW

BULLOCK GENERATORS

Direct and Alternating-Current MOTORS

COMPLETE LIGHTING AND POWER PLANTS

SEND FOR BULLETINS

BULLOCK ELECTRIC MFG. CO. CINCINNATI, OHIO, U. S. A.

479

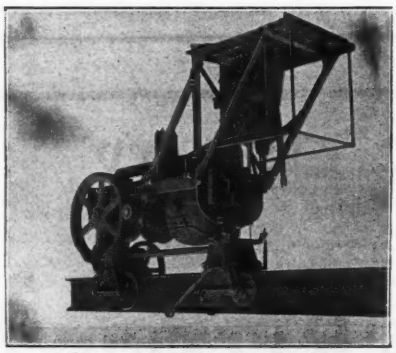
DYNAMOS AND MOTORS

Eck Dynamo and Motor Works, BELLEVILLE, N. J.

TRADE MARK

THE BROWN HOISTING MACHINERY CO.

MANUFACTURERS OF



"Brownhoist" Electric Trolley

ELECTRIC TROLLEYS AND TRAMRAIL EQUIPMENT

WORKS, CLEVELAND, OHIO

NEW YORK PITTSBURG LONDON

ELECTRIC LAUNCHES

A PAYING INVESTMENT AT PARKS AND PLEASURE RESORTS

Can't Explode

SIMPLE IN CARE RELIABLE IN OPERATION

No Heat - No Smoke - No Smell

THE ELECTRIC LAUNCH COMPANY

Avenue A and North Street BAYONNE CITY, N. J.

H. C. ROBERTS ELECTRIC SUPPLY CO.

831 ARCH ST., PHILADA., PA.

THE BEST GOODS AT FAIR PRICES

HYLO

SALESMEN WANTED

In any town where the electric light company does not keep HYLO lamps in stock we want a salesman. The electrician and repair man can make extra money selling the HYLO as a side line.

Send 75 cents for sample by mail. Write for agent's contract and state your experience fully.

THE PHELPS COMPANY, 29 Rowland Street, Detroit, Mich., U. S. A.

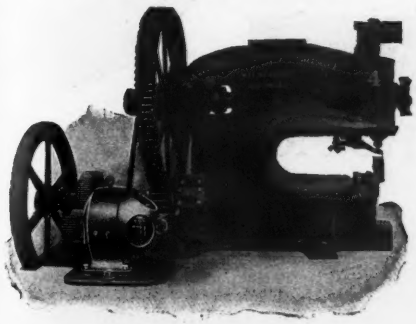
Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 14, 17, 19, 21, 24, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

"MOTOR DRIVEN TOOLS"

BULLETIN No. 24

Comprising a Series of Illustrations of the Motor Drive of Machine Tools

A copy will be sent upon request



THE
CROCKER-WHEELER COMPANY

Sales offices in all large cities

Office & works AMPERE, N. J.

TRADE **G. I.** MARK

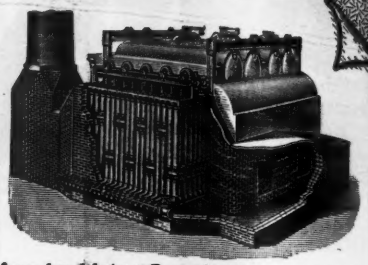
Stands for Mechanical and Electrical Perfection.

General Incandescent Arc Light Co.
New York, N. Y., and All Large Cities

INCREASED STEAM GENERATING CAPACITY

THE GREEN'S

ECONOMIZER



as a boiler adjunct will not only increase its steam generating capacity, but will decrease repairs. The reserve water heated to 250 degrees prevents unequal expansion and contraction, thus prolonging the life of the boilers and preventing necessity for repairs.

FUEL BILL DECREASED 10 to 20 PER CENT

See our free booklet, "Green's Economizer."

(2)

The Green Fuel Economizer Company

Sole Manufacturers in the U. S. A.

MATTEAWAN, N. Y.

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Shelby Electric Co
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Siggers & Siggers
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Standard Pole & Tie Co
Standard Underground Cable Co.

(*Continued on page 28.*)

HYLO

LONG LIFE 4,000 HOURS

The big filament of the HYLO lamp is 16 candle-power, 3.6 watts efficiency with a life of 1,000 hours. It is made with extreme care and sold on a selection as close and with inspection and tests as rigid as can be obtained from any factory making common lamps.

There is no mystery about the HYLO "baby" filament. It takes a small amount of current because it is small and it lasts a long time (3,000 hours) because it takes so little current that it never is strained.

The two filaments have a combined life of 4,000 hours on the average, and the total life of the lamp will depend somewhat on what proportion of the time it is turned down. Where the consumer buys lamps a judicious use of the HYLO does not increase the yearly cost for lamps. The comfort and current saving is clear gain.

THE PHELPS COMPANY, 29 Rowland Street, DETROIT, MICH., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 14, 17, 19, 21, 23, 27, 29, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

You Don't Get These
WHEN YOU BUY
BRYAN-MARSH LAMPS

THE NEW ENGLAND ENGINEERING COMPANY

remodels and reorganizes Electric Railways, Electric Light and Power Plants, Gas and Water Works, or any other engineering installations. It can

Make Your Plant Pay

or it can build a new one for you that will pay from the start.

Among the late contracts awarded the New England Engineering Company are the following:

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Contract for steam plant, ventilating plant and electric plant for the Home for Aged Men, in Brooklyn, N. Y.

The New England Engineering Company

100 BROADWAY, NEW YORK, and WATERBURY, CONN.

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COLD LIGHT FOR HOT NIGHTS

Although a great deal colder than a gas-jet, the common 16 candle-power lamp is far from frigid. Its heat is unbearable at times. In fireproof vaults, telephone booths, closets and other close, dark corners which abound in a city, the HYLO lamp will reduce the summer temperature. It makes no discoverable heat when turned down, and gives light enough for nearly all purposes. When the day is cool, or the need for a bright light great, the HYLO can be turned up instantly.

The ½–8 candle-power HYLO, when turned down, makes light enough for safety, comfort, hospitality, or propriety, but not enough light to attract inquisitive and troublesome insects. The summer cottage looks cheerful, inhabited, hospitable if the "baby" filament is burning everywhere from porch to bedroom. Freedom from heat and insects without total darkness or inconvenience can only be secured by using HYLO lamps.

The station manager will note here a case where his direct interest is with the HYLO. Summer lamps will be turned down instead of out if the HYLO is within reach of the consumer.

THE PHELPS COMPANY, 29 Rowland St., Detroit, Mich., U. S. A.

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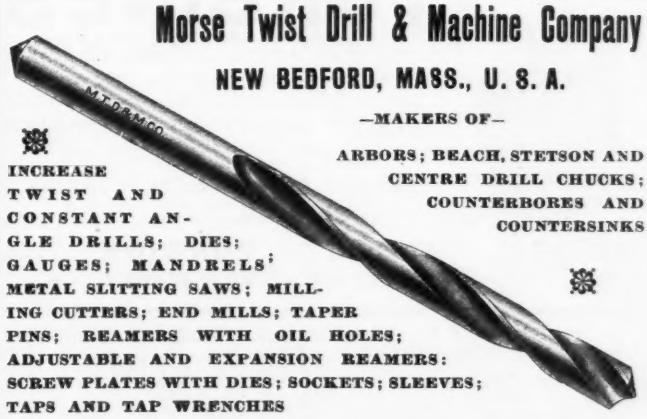

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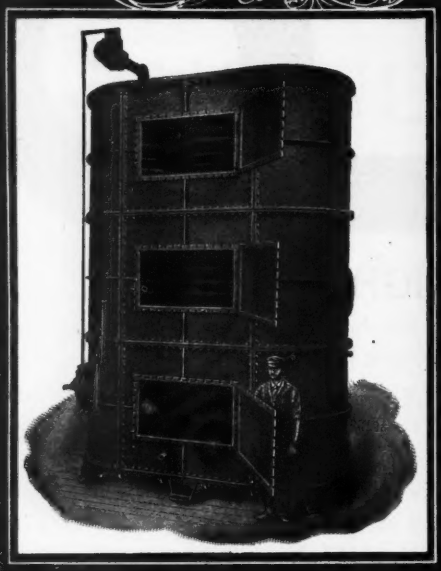

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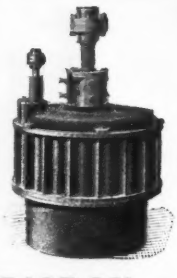

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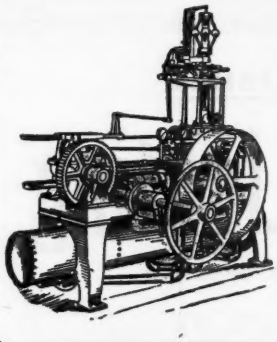

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There are a good many flat-rate stations which do not have the HYLO lamp in stock. This is as strange as it is unfortunate. We would suppose that a flat-rate manager would be willing to have lamps turned down to whatever extent possible. We tell you, Mr. Manager. that your customers will buy HYLO lamps because they make cold light for hot nights, and because they want a turn down lamp without regard to current cost. It will only take fifty HYLO lamps to test this matter. You are the man who could afford to give away HYLO lamps, where it is going to save current. You can surely not afford to refuse to sell them when you make a profit going and coming.

Would you think of putting keyless sockets up because people will not turn out lights to save current, being on flat rate? It is just as sensible to say that because your customers pay a fixed price per month they do not need the HYLO lamp. How is it about the sunlight which costs nothing per month? Do people in your town ever use window shades? And why do they use them when light is free?

Don't force your customers to get HYLO lamps by mail. Put them in stock and keep up to date. An order for 50 HYLO lamps will do it.

THE PHELPS COMPANY, 29 Rowland Street, Detroit, Mich., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 14, 17, 19, 21, 23, 24, 27, 30, 31, 33, 43, 44, 47, 48, 51 and 52.

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A Pullman sleeping car of latest construction is now attached to New York Central train leaving Grand Central Station at 4.00 P. M., daily, running through over the Michigan Central, arriving Grand Rapids at 12.55 P. M. next day, connecting in Union Station for all points in Western Michigan. For information and sleeping car reservations inquire of New York Central Agents.

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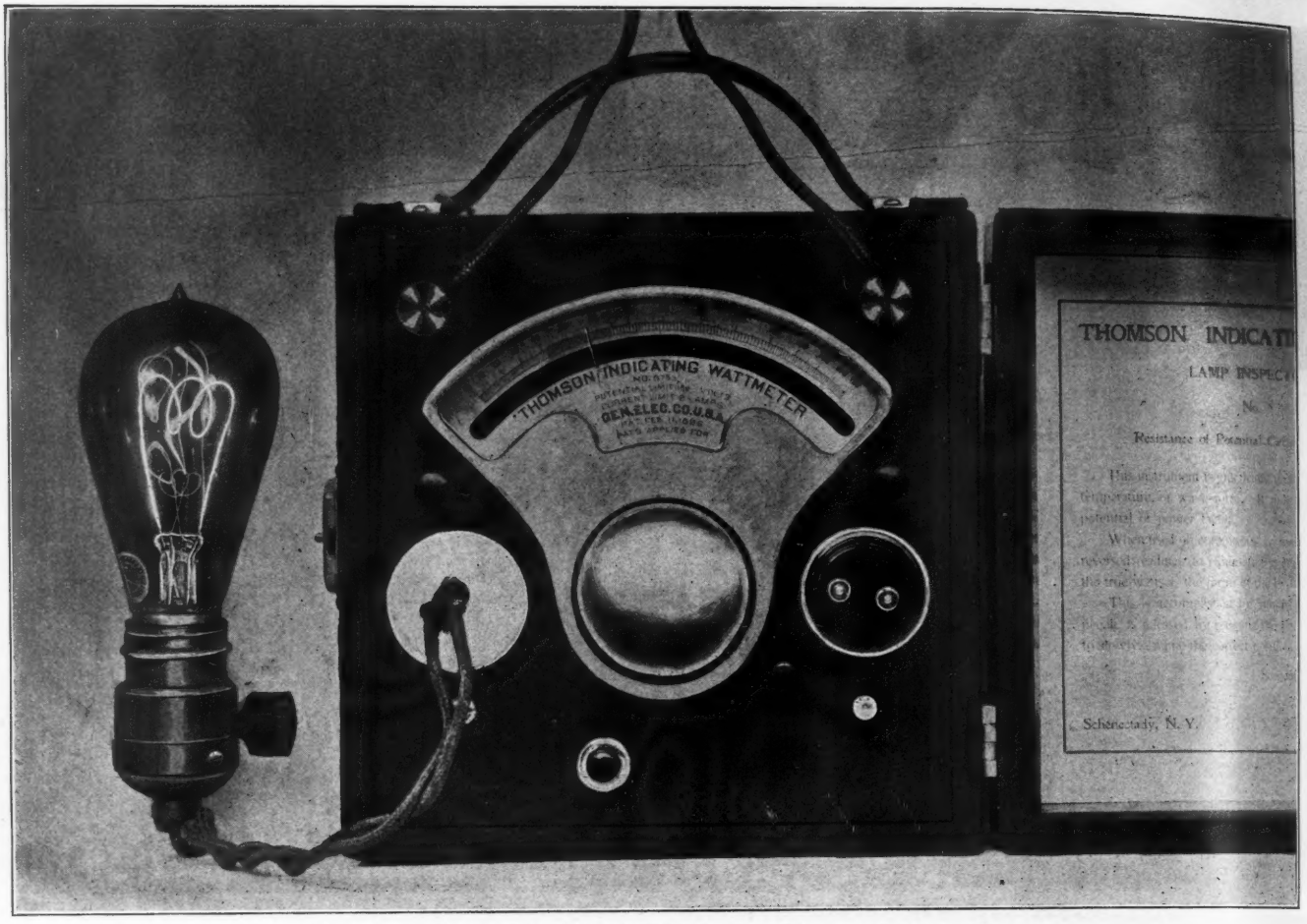
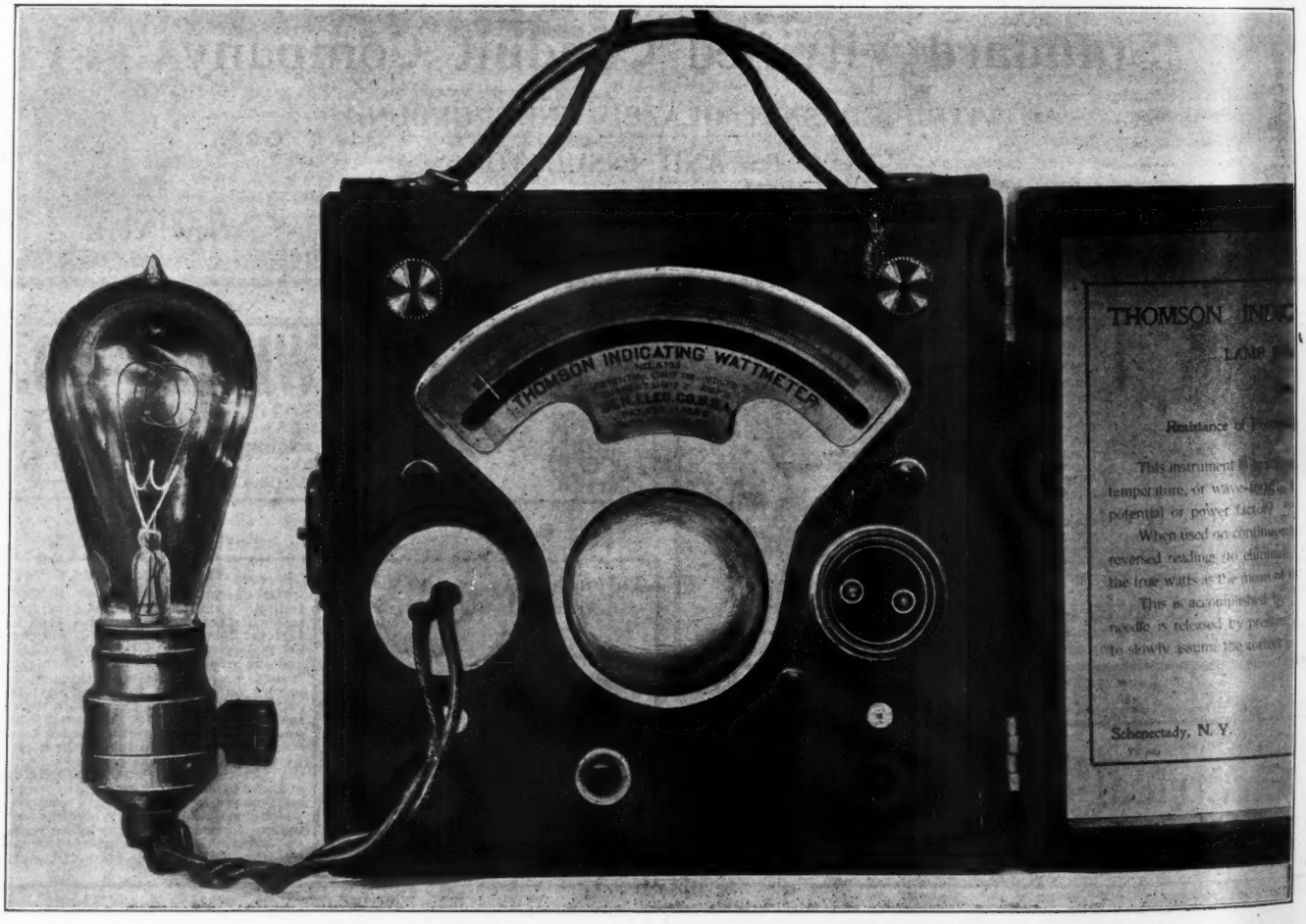


PHOTOGRAPH OF HYLO LAMP TURNED UP (16 C.-P.)—INDICATING WATTMETER SHOWING 57 WATTS.



PHOTOGRAPH OF HYLO LAMP TURNED DOWN (1 C.-P.)—INDICATING WATTMETER SHOWING 9 WATTS.
(*See Opposite Page.*)

HYLO

LAMP TESTING BUREAU

Current Consumption of Twelve (12) HYLO Lamps Received from The Phelps Company

Lamp Number	Watts Big Filament	Watts Little Filament
13	56.0	9.64
14	55.8	7.54
15	57.3	7.78
16	57.4	9.98
17	56.2	7.78
18	58.1	7.66
19	56.6	8.01
20	56.8	8.24
21	56.2	9.40
22	57.2	8.12
23	57.6	8.12
24	55.4	7.89
Average . . .	56.7	8.35

New York, June 28, 1902.

Note.—The Lamp Testing Bureau is devoted exclusively to the investigation of incandescent lamps, and lavishly equipped with instruments for that purpose. The bureau inspects about six million lamps a year for the EDISON licensee companies. Its findings are of the highest authority.

We advertise that the HYLO saves five-sixths, and it does it!

Sample sent by mail on receipt of 75 cents.
Write for circulars and prices.

THE PHELPS CO., 29 Rowland Street, Detroit, Mich., U. S. A.

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We carry in stock, of various Voltages, Types and Finish,

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If you want a Complete Electric Installation, consult our Engineering Department.

Neeley Electric Company,

Washington, D. C.

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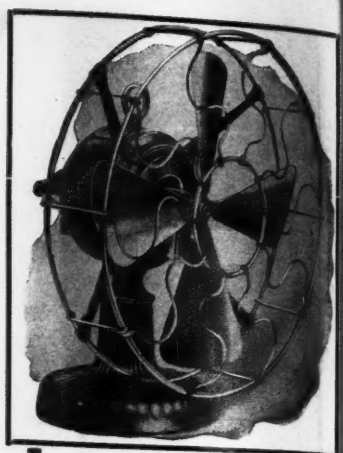

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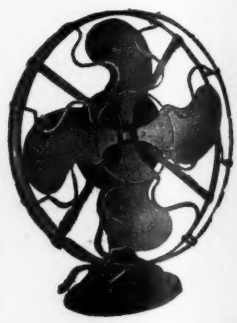

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Large stock. Will use less current, give more air and last longer than any other make.

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Contractors and central stations should buy of the regular supply dealer or lamp-maker, but if there is any delay in filling an order advise us promptly.

Our magazine advertising is intended to bring the HYLO to the attention of the lamp user and make him want it. We expect the lamp-user to buy the HYLO where he buys bells, batteries and common lamps. We do not want orders from consumers for a few HYLO lamps, but we fill mail orders as promptly as possible, and often at great pains. When the lamp-user takes the trouble to send us a mail order it generally shows that the HYLO is not properly displayed by the dealer.

Every man, woman and child in the United States who could possibly use a turn-down lamp will know all about the HYLO before we get through advertising. Since we propose to distribute HYLO lamps through regular channels in a regular way, it is good business to co-operate with us.

THE PHELPS COMPANY, 29 Rowland Street, Detroit, Mich., U. S. A.

Other HYLO ads on pages 1, 2, 4, 7, 9, 10, 13, 14, 17, 19, 21, 23, 24, 27, 29, 30, 31, 43, 44, 47, 48, 51 and 52.

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HANDLES THEM AT ANY HEIGHT OR ANGLE
Incandescent Electric Light Manipulator Co.
116 Bedford St., Boston, Mass.

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New York

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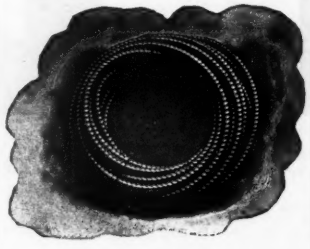
METALLIC CONDUIT

Illustrated Catalogue No. 4046



SPRAGUE

ELECTRIC COMPANY

527–531 West 34th Street, New York

DID YOU EVER SPILL YOUR ACID BOTTLE?

The ALLEN Soldering Stick
FOR ALL ELECTRIC WORK
RUB LIGHTLY WITH ALLEN SOLDERING STICK (FLUX) AND GET A PERFECT JOINT
APPLY SOLDER

THE ALLEN SOLDERING STICK (FLUX) MAKES SOLDER FLOW ON ANY METAL!

The ALLEN appeals to your intelligence along the line of least resistance. The large Stick (Flux), we gladly exchange for your address, shows you how. DO IT NOW.

L. B. ALLEN CO., Inc.,

Sole Manufacturers, 1335 Columbia Avenue, Chicago, Ill.

Also Makers of ALLEN SOLDERING PASTE AND SALTS. COMMUTATOR LUBRICANT.

MICA WASHERS

PRICES RIGHT

EUGENE MUNSELL & CO.

117 LAKE ST., CHICAGO 218 WATER ST., NEW YORK

Sterling Extra Insulating Varnish

STERLING EXTRA BLACK FINISHING VARNISH
STERLING BLACK AIR DRYING VARNISH
STERLING BLACK CORE PLATE VARNISH

The Sterling Varnish Co. PITTSBURGH, PA., U. S. A.

The Sterling Varnish Co. 95 COLMORE ROW, BIRMINGHAM, ENGLAND

EDISON MINIATURE LAMPS.

Over 400,000 Annually Shipped to Users.

ALL TYPES—EVERY VARIETY.

Prompt Shipment—In any quantity.

Miniature and Candelabra Sockets and Receptacles.
Dewar Bulbs for Liquid Air.

EDISON DECORATIVE & MINIATURE LAMP DEPT.,

General Electric Co.,
Harrison, N. J.

2

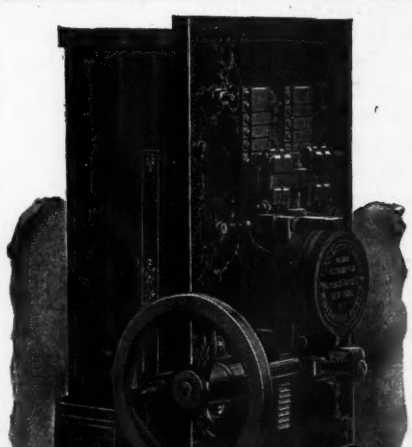
THE WYCKOFF PIPE & CREOSOTING CO. : : :

Portsmouth, Va.

MANUFACTURERS OF

Wyckoff Wooden Conduits,

CROSS-ARMS AND LUMBER.



Automatic Reversible Elevator Controller

Construction absolutely fireproof. Tubular resistance of ample capacity. Heavy brass contacts renewable from the face of the slate. Powerful ratchet movement operated by eccentric. Graphite bearings requiring no oil. Slow speed of 300 R. P. M. Suitable for direct connection to elevators, lifts, hoists, etc., or any service requiring a rapid start, stop, and reversal of the motive power.

AUTOMATIC SWITCH COMPANY 131 Liberty St. New York, N. Y.

FOR HIGH GRADE

INSULATING VARNISHES

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LONDON NEW YORK CHICAGO

STANDARD 17 YEARS

P & B TAPE

Supremely Durable. Always Water-proof and Pliable.
Perfect and Permanent Insulation Assured. . . . . .

THE STANDARD PAINT COMPANY

NEW YORK Dept. I. CHICAGO

NEW RAILROAD SIGNAL SYSTEM.

The New York Central Railroad Company has contracted for the equipment of the Putnam Division of the Hudson River Road from 155th street to Yonkers, N. Y., with a new system of electro-gas block signals, to be operated on the normal danger plan. The signal blades or semaphore arms are positively held by gravity to a horizontal position by carbonic acid gas pressure in a cylinder placed in each signal-post. The valve controlling the flow of gas from the tank to the cylinder is closed or released by an electric current passing through the rails. This is done automatically by the presence, or otherwise, of a train from behind. The electric connections are such that the signal blade stands normally at danger. When the locomotive approaches it the engineer sees the blade down at safety if it is safe to go ahead, or the blade remains up at danger if there is a train, open switch or broken rail ahead

Two Tours to the Pacific Coast via Pennsylvania Railroad.

Leave New York August 2, visiting Chicago, Denver, Colorado Springs, Salt Lake City, San Francisco, Del Monte (Monterey), Santa Barbara, Los Angeles, San Jose, and Portland on the going trip.

Returning, Tour No. 1 will run eastward through the magnificent Canadian Rockies by leisurely daylight trips, with stops at Glacier, Banff Hot Springs and other points, reaching New York on August 31.

Tour No. 2 will run eastbound via Yellowstone National Park, including the usual six-day trip through that interesting preserve, arriving New York September 4.

Special trains will be provided.

Rates from New York, Philadelphia, Washington, or any point on the Pennsylvania Railroad east of Pittsburg, including transportation, Pullman berth, and all meals on the tour except during the five days spent in San Francisco, when Pullman accommodations and meals are not provided:—

For Tour No. 1, $300. Two persons occupying one berth, $180 each.

For Tour No. 2, $250, including all expenses through Yellowstone Park. Two persons occupying one berth, $230 each.

A preliminary announcement outlining the various details will be furnished upon application to Ticket Agents, Tourist Agent, 1196 Broadway, New York, or Geo. W. Boyd, Assistant General Passenger Agent, Pennsylvania Railroad, Broad Street Station, Philadelphia. (2)

NEW JERSEY A UNIQUE SPOT.

New Jersey is the Natural Summer Resort for New Yorkers and for the Easterner as well for the simple reason that it is accessible. Exceptional train service, fine locations, wonderful bathing facilities, and a marvelous climate are the chief attractions. The popular route is the Sandy Hook, which leaves New York, Pier 8, N. R., and runs to Atlantic Highlands, where connection is made with the New Jersey Central for all New Jersey Coast resorts, including Seabright, Normandie, West End, Monmouth, Long Branch, Asbury Park, Allenhurst, Ocean Grove, Avon, Belmar, Spring Lake and Point Pleasant. The boats which comprise the fleet are models in convenience and equipment, and are the fastest plying from New York. The sea trip is delightful, and the rail portion of the journey is close to the water's edge. The New Jersey Central also operates a rail line to these resorts, passing Shrewsbury, Red Bank, Matawan, Beach Haven, Atlantic City, Ocean City and Cape May. Its trains are fast, frequent and finely equipped, and the principal ones have Buffet Parlor Cars. The General Passenger Department of the New Jersey Central, Sect. G. B., has just issued a hotel book, giving information regarding the principal hotels and boarding houses on its line. It's free for the asking, send for it.

REDUCED RATES TO TACOMA.

On account of the meeting Y. P. C. U. of the Presbyterian Church, at Tacoma, Wash., July 23 to 27, the Pennsylvania Railroad Company will sell excursion tickets to Tacoma, Portland, Seattle, Vancouver, or Victoria, from all stations on its lines, from July 10 to July 20, inclusive, at greatly reduced rates. These tickets will be good for return passage until September 15, inclusive, when executed by Joint Agent at destination and payment of 50 cents made for this service. Apply to Ticket Agents for additional information. (2)

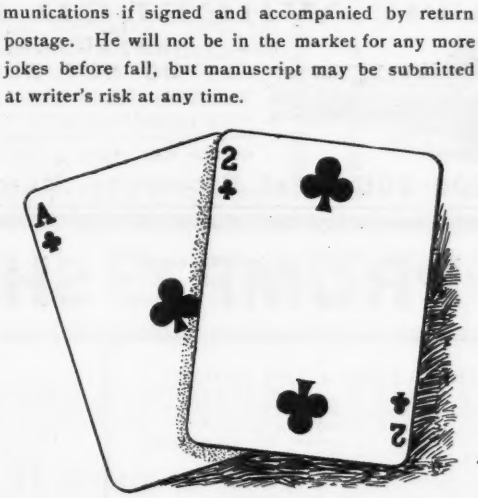
HYLO

HILARITY

Jokes, ranging in brightness from 1 to 16 candle-power

It is best to be serious with some people all the time and with all people some of the time, but it is not in accordance with the latest psyco-physical theories to be serious with everybody all the time. Our page of HYLO hilarity will, we hope, be taken by everybody, both the serious and the joker, in the spirit in which it is printed.

This page is solely and entirely light and trifling. Nothing here is to be taken seriously or wrong side out or upside down. The editor will answer all communications if signed and accompanied by return postage. He will not be in the market for any more jokes before fall, but manuscript may be submitted at writer's risk at any time.



Find the name of the only successful turn-down lamp.

Yes, the HYLO is "only in its infancy." Some day the baby filament will grow up and then you will be surprised.

You are quite right; the HYLO lamp has a great "future," and as you suggest it is a fine thing in a bath-room. There are other places where the HYLO can be used to advantage. The interior of the Pyramids, the Catacombs and the sewers of Paris all need the HYLO lamp. Had you thought of that?

Why is the HYLO baby filament lamp the greatest paradox of the year?

Because when it is turned down to one candle-power it sheds more light on the ever interesting subject of economy.

HYLO! by-lo! time to go to bed,
HYLO! by-lo! little sleepy head.
Turn down the HYLO, baby's going to by-lo—
HYLO! by-lo! cuddle down in bed.

"Pa, what is a dim religious light?"

"The light, my son, which the HYLO lamp makes when turned down. You never hear stumbling over furniture and profane remarks where they use the HYLO."

Where 'ere the mother is singing by-lo,
Be she "Yank" or Turk,
You can bet your life the HYLO
Lamp is getting in its work.
Dedicated to the Old Maids' Association for the Promotion of Parental Culture.

Our "Jack" and "Game" lamps are not yet ready for the market. It is violating no confidence to announce that they will cause your hair to curl. Some people think that we ought to have named ourselves The Seven-Up Company. There is such a tempting suggestiveness about the two first syllables of that name HYLO.

AN ESSENTIAL PART OF THE HYLO LAMP

A Baby "Fill-ment."

Wilkins—"Will there be HYLO lamps in Heaven?"

Bilkins—There ought to be, old man, for if you transpose the vowels you make H-y-l-o H-o-l-y.

Question—Why is a HYLO not a HYLO?
Answer—Because it can't be turned down.
You all have to have it.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JULY 8, 1902.

703,980 Combined switch and lightning arrester; W. J. Bell, Baraboo, Wis.

703,984 Supporting device for electric lamps; W. F. Brewster, New York.

703,985 Electric locomotive crane; G. M. Brill, Philadelphia, Pa.

703,989 Magneto-therapeutic apparatus; J. Burry, Fort Lee, N. J.

704,019 Electrical transportation system; H. F. Freed, Harrisburg, Pa.

704,023 Telegraph; C. E Fritts, New York, N. Y.—A circuit for variable currents, having the sections adjusted to enable the desired current to flow over the line by the interposition of condensers suited to the electrical resistances in the sections.

704,092 Contact system for electric railways; T. B. Patch, N. Cambridge, Mass.

704,099 Electric motor regulation; O. H. Pieper, Rochester, N. Y.—A motor for alternating currents, com

(Continued on page 46.)

HYLO

The only turn-down lamp made for all sockets in all voltages.

THE PHELPS CO.,
29 Rowland St. - Detroit, Mich.

M. J. BLAKE MICHAEL BLAKE

M. J. & M. BLAKE
IRON AND STEEL SCRAP
79 TENTH AVENUE
COR. 15TH STREET
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MONTREAL, CANADA R. E. T. Pringle Co., Ltd.

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MANUFACTURERS OF
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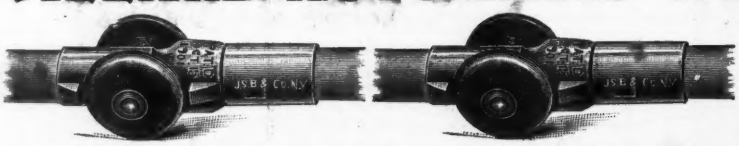
MODEL MAKERS.
Electrical, Experimental and Fine Tool Work
Write for Booklet.
The Franklin Gas Engine Sets of Castings and Material; Finished Parts and Complete Engines. Write for Gas Engine Circular No. 2. Telephone, 126 Madison Square.
THE FRANKLIN MODEL SHOP,
129-131 West 31st Street, New York City.

VILLARD AUTOMATIC WHEELED DUCT RODS



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DO NOT BUCKLE OR ZIGZAG

The wheels eliminate friction. Impossible to uncouple while pushing or pulling through conduits. Two men with these rods can do twice the work of four using the old style. Send for descriptive circular with prices.

JAMES S. BARRON & CO., 200-206 West Broadway, New York, Sole Agents

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RAILWAY GENERATORS
DIRECT-CONNECTED

1—850-kw., Type M. P., 12-850-80 R. P. M., and 28 and 52 x 48 Cross Compound, Pennsylvania Iron Works Co., Corliss.

1—900-kw. Siemens Halske, and 21 x 20 High Speed Auto Engine.

BELTED

1—500-kw. General Electric, M. P.
1—300-kw. General Electric, M. P.
3—225-kw. General Electric, M. P.
2—200-kw. General Electric, M. P.
2—150-kw. Westinghouse, M. P.
1—120-kw. Westinghouse, M. P.
4—100-kw. General Electric, M. P.
2—100-h.-p. Westinghouse, M. P.
3— 60-kw. Edison, Bipolar, M. P.

ARC DYNAMOS

2—No. 12 Brush, 125 Light, 9.6 amp., multi-circuit.
2—No. 11 Brush, 125 Light, 9.6 amp., multi-circuit.
1—No. 9 Brush, 125 Light, 6.6 amp., multi-circuit.
2—No. 9 Brush, 80 Light, 9.6 amp.
3—No. 8 Brush, 65 Light, 9.6 amp.
4—M. D. 2, T.-H., 50 Light, 9.6 amp.
4—L. D. 12, T.-H., 50 Light, 6.6 amp.
1—M. D. 12, T.-H., 75 Light, 6.6 amp.

ARC LAMPS

Lot of No. 31 Brush, T. H. M. 12, M. 2, K. 12, K. 2.
Lot of Manhattan and Jandus, Direct Current.

ALTERNATORS—2 AND 3 PHASE

2—150-kw. G. E., 3-phase, 2200 volts, 60-cycle.
1—150-kw. G. E., 3-phase, 2300 volts, 120-cycle.
1— 75-kw. Westinghouse, 2-phase, 2200 volts, 60-cycle.
1— 75-kw. G. E., 2-phase, 2200 volts, 60-cycle.
1 - 75-kw. Stanley, 1100-2200 volts, 120-cycle.
1— 60-kw. Stanley, 1100-2200 volts, 60-cycle.
1— 50-kw. Stanley, 1100-2200 volts, 120-cycle.
2—250-kw. G. E., 3-phase, 60-cycle, 10,000 volts. Type A. T. B. 16-250-450.
2—330-kw. Stanley, 2-phase, 60-cycle, 2500 volts, direct-connected to 18 and 30 x 24 Tandem Russell Engine, 160 R. P. M.

ALTERNATORS—SINGLE PHASE

2—A120 G. E., 1050 volts, 120-cycle.
1—A100 G. E., 1050 volts, 120-cycle.
2 - A70 T.-H., 1050 volts, 120-cycle.
4—A60 G. E., 1050 volts, 120-cycle.
2—A35 T.-H., 1050 volts, 120-cycle.
1—250-kw. Westinghouse, 1100 volts, 120-cycle.
1—120-kw. Westinghouse, 2200 volts, 120-cycle.
2— 60-kw. Westinghouse, 1100 volts, 120-cycle.
1— 45-kw Westinghouse, 2200 volts, 120-cycle.
1— 45-kw. Westinghouse, 1100 volts, 120-cycle.
1— 45-kw. Westinghouse, 2300 volts, 60-cycle.
1—100-kw. Ft. Wayne, 2600 volts, 120 cycle.
2 150-kw. Ft. Wayne, 1100 volts. 120-cycle.
1 - 375-kw. G. E., Class 80-375-90-2300 volts, 60-cycle, direct-connected to a 20 and 36 x 48 Cross Compound, E. P. Allis Tangye Frame Engine.

110-VOLT—DYNAMOS

2—100-kw. Edison.
1—100-kw. M. P. Westinghouse.
3 - 60-kw. Edison.
1— 50-kw. Thomson-Houston.
1 - 50-kw. Siemens Halske.
3— 45-kw. Edison, self-oiling.
3 - 30-kw. Edison, self-oiling.
3— 25-kw. Edison, self-oiling.
1— 15-kw. Edison, self-oiling.

500-VOLT—MOTORS

Have just received at factory a large lot of very fine motors, in sizes up to 25 h.-p.

ENGINES

1—18 x 42 Hamilton-Corliss.
1—20 x 48 Geo. H. Corliss.
1—18 x 48 Hamilton-Corliss.
1—18 x 48 Greene.
1—15 x 23 x 17 Tandem McIntosh & Seymour.
1—12 x 20 x 12 Comp. Westinghouse.
1—18 x 37 x 16 Comp. Westinghouse.
1—18¼ x 18 McIntosh & Seymour.
2—18½ x 18 Armington & Sims.
1—18¼ x 18 Ideal Auto.
2—15½ x 15 Armington & Sims Auto.
1—14 x 16 New York Safety Power.
2—13 x 14 Watertown Auto.
2—13 x 12 Erie Ball.

BOILERS

1—72" x 17' return tubulars.
1—Battery, 4.72" x 16' return tubulars.
2—175-h.-p. Sterling, water tube.
1500-h.-p. B. & W., water tube, in various sizes.

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DRY STEAM Lubrication PROTECTED by using DEARBORN BOILER COMPOUNDS
Made to suit the water as per analysis
New Boiler Compound Feeder Will Feed Any Kind of Compound Write for Particulars

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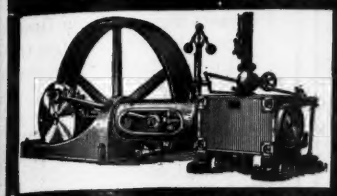
ALLIS-CHALMERS CO.,
GENERAL OFFICES CHICAGO, HOME INS. BLDG.



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PUMPING, BLOWING AND HOISTING ENGINES.
RIEDLER PUMPS AND COMPRESSORS.
SPECIAL ENGINES FOR STREET RAILWAYS AND ELECTRIC LIGHTING.

The Ball & Wood High-Speed Engine
is noted for its smooth and silent running and its extremely low cost of maintenance. It is recognized as the standard engine for electric light and railway plants. BALL & WOOD engines are made in all types for all services requiring the best economy and efficiency
THE BALL & WOOD CO.
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AMERICAN BALL DUPLEX COMPOUND ENGINE AND DIRECT-CONNECTED GENERATOR

The most economical plant for generating electric currents, and the most compact plant that has yet been produced.
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OVER 3,000 PLANTS IN OPERATION

SAVES EXPENSE in high coal bills
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Simple and Durable in Its Construction.
Cost Low and Very Economical in Maintenance.
No Waste of Lime or Soda Reagents.
No Renewal of Filtering Material Necessary.
We guarantee our plants to do the work claimed.
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2–100 K. W., General Electric " "
1–100 K. W., Edison Bipolar " "
1– 80 K. W., Detroit " "
1–100 K. W., Mather " "
2–D62 Thompson-Houston " "

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75 K. W., 100 K. W., and 120 K. W., G. E.
60 K. W., G. E., 75 K. W., Westinghouse.
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SINGLE, TWO AND THREE-PHASE
60 and 120 CYCLES
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100 h.p. " "
125 h.p. " "
500 h.p. Heine, new.
250 h.p. "
250 h.p. Abendroth & Root.

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36 x 60 Hamilton-Corliss.
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16 x 42 Greene.
10 x 18 x 20 Payne Tandem Compound.
12 x 23 x 18 McEwen Tandem Compound.
18 x 16 Erie Ball.
15½ x 15 Armington & Sims.
12 x 20 x 12 Westinghouse Compound.
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NUMBER OF BRAND NEW EDDY MOTORS 110, 220 AND 500 VOLTS, RANGING IN SIZES FROM 1 H.-P. TO 12 H.-P.
LARGE LOT GENERAL ELECTRIC TYPE F AND TYPE H TRANSFORMERS, FROM 12 LIGHT TO 120 LIGHT. EXCELLENT CONDITION.
RAILWAY ARMATURE COILS FOR G. E. 800, 1200, 52, AND WESTINGHOUSE 3, 49, 38B, 12A AND 68. FIRST-CLASS GOODS AT VERY LOW PRICES.

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WORK GUARANTEED—WRITE FOR PRICES

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PATENTS.

(*Continued from page 44.*)

prising field windings, armature coils, commutator and commutator brushes arranged at the neutral point, all connected in series, as customary in constant-current motors, and a regulating device for controlling the speed of the motor consisting of a variable resistance permanently in shunt across the armature.

704,108 Programme clock; O. D. Rice, Winthrop, Mass.

704,113 Circuit closer for portable electrical apparatus; W. Roche, Jersey City, N. J.

704,115 Thermostat; A. Roesch, Bridgeport, Ct.

704,117 Signaling system; J. J. Ruddick, Newton, Mass.

704,125 Battery; W. T. Seddon, Minersville, Pa.

704,127 Combined district telegraph and telephone signal; Chas. Selden, Baltimore, Md.

704,135 Station indicator; H. T. Smith, Christchurch, New Zealand.

704,165 Telegraphic safety device; S. R. Wright, Morton, N. Y.

704,172 Insulator; J. E. Calvin, Camptonville, Cal.

704,177 Electrical apparatus for operating railway switches and signals; Theo. Ducousso, Paris, France—A transmitting commutator, a lever for working it, pawls on said lever acting in opposite directions, a current-controlled bolt, and means for projecting said bolt into the path of said pawls in case of accidental throwing of the switch.

704,202 Switching apparatus; G. Michalke, Charlottenburg, Germany.

704,245 Means for transmitting rotary motion; P. W. Dunne, River Forest, Ill.

704,246 Burglar alarm; P. W. Dunne, River Forest, Ill.

704,247 Burglar alarm; C. Fruehauf, Chicago, Ill.

704,252 Process of making plates for storage batteries and products thereof; H. K. Hess, Philadelphia, Pa.

704,264 Controlling system for electric hoists or elevators; A. E. Macoun, Braddock, Pa.—A reversing controller and a hand-controlled cutout switch included in the circuit, and a mechanism connected with the cutout switch operated by the movement of the hoist and arranged to automatically break the main circuit when the car has reached the limit of its travel.

704,268 Coin collector for telephone toll lines; J. J. O'Connell, Chicago, Ill.

704,303–304 Reversible electrode battery; T. A. Edison, Llewellyn Park, N. J.

704,305 Electrode for batteries; T. A. Edison, Llewellyn Park, N. J.

704,306 Reversible galvanic battery; T. A. Edison.

704,322 Electrical push and switch; E. G. Harcourt, Birmingham, England.

704,323 Automatic electric semaphore signal; J. N. Harper, Kansas City, Mo.

704,336 Reversing switch motor; J. D. Ihlder, Yonkers, N. Y.—A plurality of electrically operated switch-arms, a safety device controlled by the movement of one switch-arm and controlling the movements of another switch-arm, whereby the switch-arms are operated in a predetermined order or succession.

704,377 Controlling system for electric elevators; J. D. Ihlder, Yonkers, N. Y.—The combination of controlling circuits of different potentials reciprocally controlling each other.

704,338 Controlling system for electric elevators; J. D. Ihlder, Yonkers, N. Y.

704,347 Railroad signaling system; A. W. Knee, Syracuse, N. Y.

704,361 Electric cutout; G. N. Oehmen, Brooklyn, N. Y.

704,371 Voltage regulator; T. M. Pusey, Kennett square, Pa.

704,393 Manufacture of iron, manganese and alloys by aid of electricity; Albert Simon, Bordeaux, France.

704,398 Safety device; Aug. Sundh, Yonkers, N. Y.

704,399 Stained-glass window and method of making same; J. Taluac, Philadelphia, Pa.

704,400–401 Method of framing glass; J. Taluau, Philadelphia, Pa.

704,417 Igniter; C. A. Wilkinson, Worcester, Mass.

704,424–425 Junction box for electric wires in buildings; B. W. Allen, Boston, Mass.

704,439 Thermal protector for electric circuits; F. B. Cook, Chicago, Ill.

704,446 Watch-dial illuminator; F. M. Durkee, Newton, Mass.

704,447 Protective operating device for electric motors; A. C. Eastwood, Cleveland, Ohio.

704,448 Rheostat; A. C. Eastwood, Cleveland, Ohio.

704,453 Means for changing the tension of currents; W. M. Fairfax, Brooklyn, N. Y.

704,484 System of electric distribution; C. J. A. Michalke, Charlottenburg, Germany.

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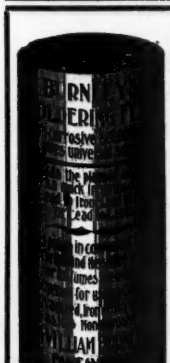
WANTED SALESMEN FOR INCANDESCENT LAMPS
State age, whether married or not, electrical experience, whether college graduate, what degree, and territory familiar with. Address
"INCANDESCENT"
Care ELECTRICAL REVIEW New York

SALESMAN WANTED
In every section who personally visits the electrical supply trade, street railways, electric light and telephone companies, to sell, in addition to his present line, a well advertised electrical specialty. Address
M. C. B.,
Care ELECTRICAL REVIEW,
21 Park Row, New York.

FOR SALE
One 1,000 K. W., direct-connected, vertical, cross-compound, side crank McIntosh & Seymour engine now completed. Revolutions per minute 120. Steam pressure 125 pounds. Rated load and indicated horse power 1520. Cut off $\frac{2}{3}\frac{4}{0}$. This engine was ordered previous to our purchase of the Citizens' Light and Power Company. We now wish to dispose of same at a bargain. The engine can be seen at the McIntosh & Seymour Factory, Auburn, N. Y.
Address, Electrical Department, Rochester Gas and Electric Co., Rochester, N. Y.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The Burnley Battery and M'f'g Co.
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OF EVERY DESCRIPTION
"Unit" Enamel Rheostats
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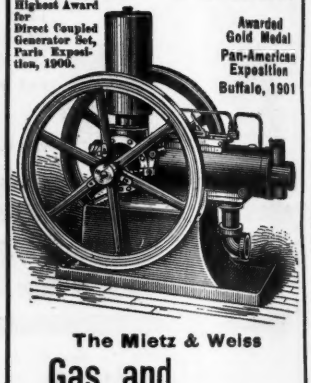
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Close Regulation.
For Electric Lighting, Charging Storage Batteries and all power purposes. Send for Catalogue.
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Without the friendship of the consumer there is no permanent success in any line. The HYLO has this friendship. Ask any man or, better still, any woman who has been using a HYLO lamp for a few months and you will find enthusiastic commendation.

Circulars and price lists await your request (a postal card will bring them).
Sample by mail on receipt of 75 cents.

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The Schwerdtle Stamp Co.
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Smith & Hemenway Co.
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(*Continued on page 48.*)

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has already become, is destined to remain, the GENERIC name for a turn-down lamp, but

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The name "HYLO" is registered as a trade-mark and owned by

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Merely give us your ear and consider our

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Telephones that never wear out. Magnets that never deteriorate. Carbon that never disintegrates. Toll Boards that take care of themselves. Switchboards that never give trouble. Multiple Boards for exchanges—all sizes. Current Protectors that never fail.

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A trial will justify our statement that we are in a position to furnish your work at rock bottom prices.

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controls, regulates, insures engine service. If you are not familiar with the system and its operation it will prove time well spent to look through the booklet illustrating the subject

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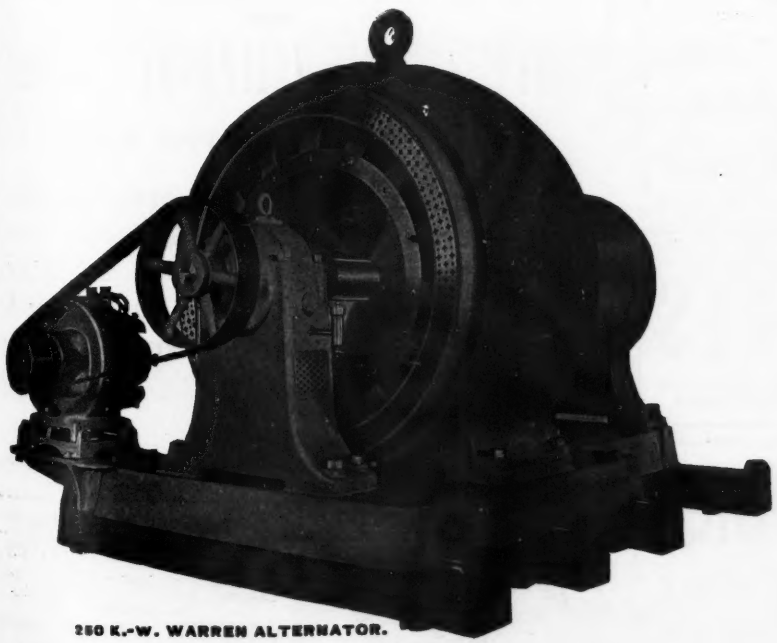

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of the past has possessed an inherent regulation far surpassing any other alternator known. By inherent regulation is meant the quality of maintaining a given voltage without the use of any extraneous device, such as compounding coils, which in all cases require compensating commutators with brushes, collector rings, etc. Remove these devices from any known alternator and the generator would be practically useless.

A recent discovery as to the actual relation of copper to iron as applied in an Inductor Alternator has led to a still further improvement, to the extent of securing an actual working regulation close to perfection, and this still without the necessity of compounding or other external devices.

ALL WARREN ALTERNATORS
of the future will embody this improvement

REGULATION WILL HENCEFORTH BE OUR CHALLENGE

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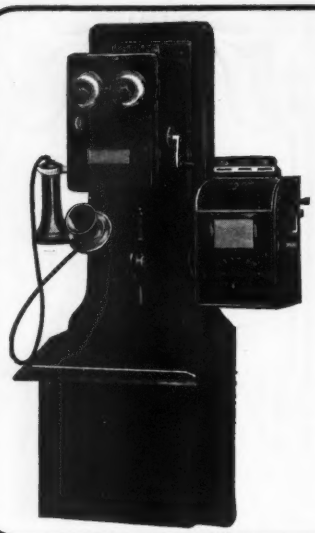
Thos. Muir & Son, Detroit, Mich
Western Electrical Supply Co., St. Louis, Mo.
C. W. Hobson, Waco, Texas.
Kilbourne & Clark Co., 215-217 Second Ave., Seattle, Wash., Pacific Coast Agts.
Florida Electric Co., Jacksonville, Fla.



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TELEPHONES
AND EVERYTHING ELECTRICAL

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Connectors and Terminals.
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always at arm's reach yet takes up no room on the desks. To call central, lower hand 'phone. Cost no more than ordinary desk sets. Unequaled for residence use. Write for our complete catalogue.

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MAKERS OF
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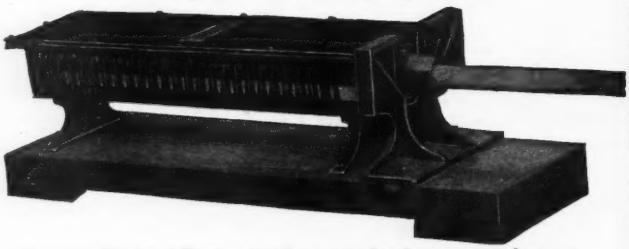

TERMINAL HEAD FOR TWENTY-FIVE PAIR, WITH LID SECURED, AND SHOWING FUSES IN POSITION

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PORTLAND, OREGON, and SPOKANE, WASHINGTON
WHOLESALE PRODUCERS
50-Foot to 80-Foot Poles Our Specialty

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Highest Awards at National Export, Central Canadian, Pan-American and Charleston Expositions.
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Linemen's Tools
Catalogue Free. Send for one.
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THE PHELPS CO., 29 Rowland St., DETROIT, MICH., U. S. A.

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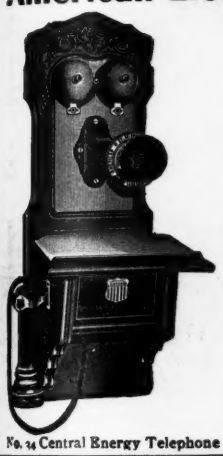
American Electric Telephone Co.



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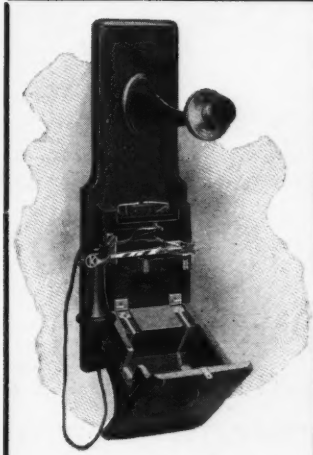

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Better than the "Bell Solid-Back"

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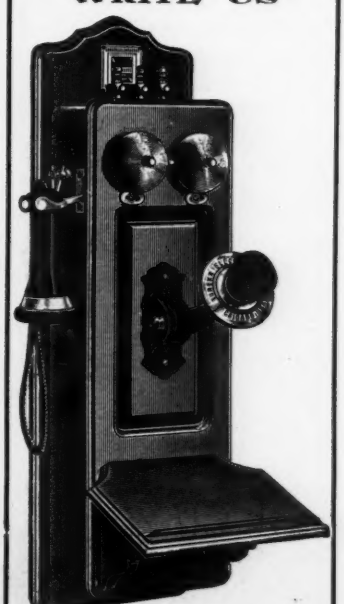

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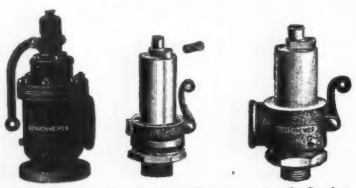
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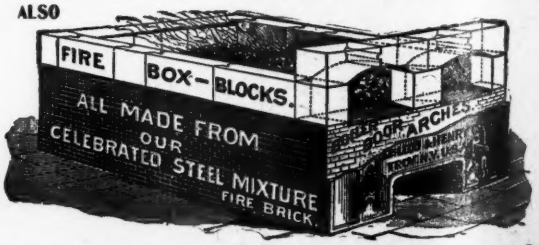

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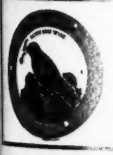

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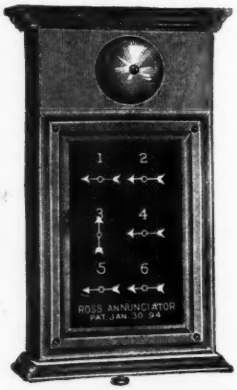

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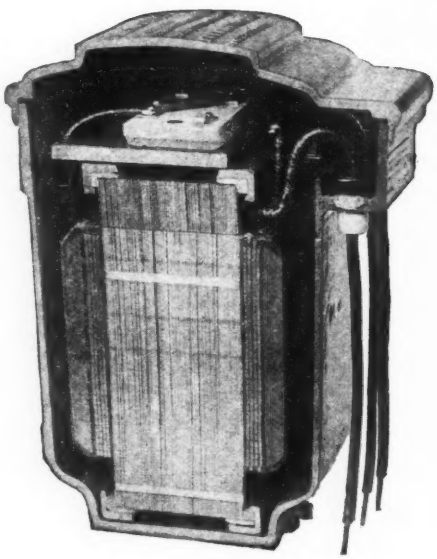

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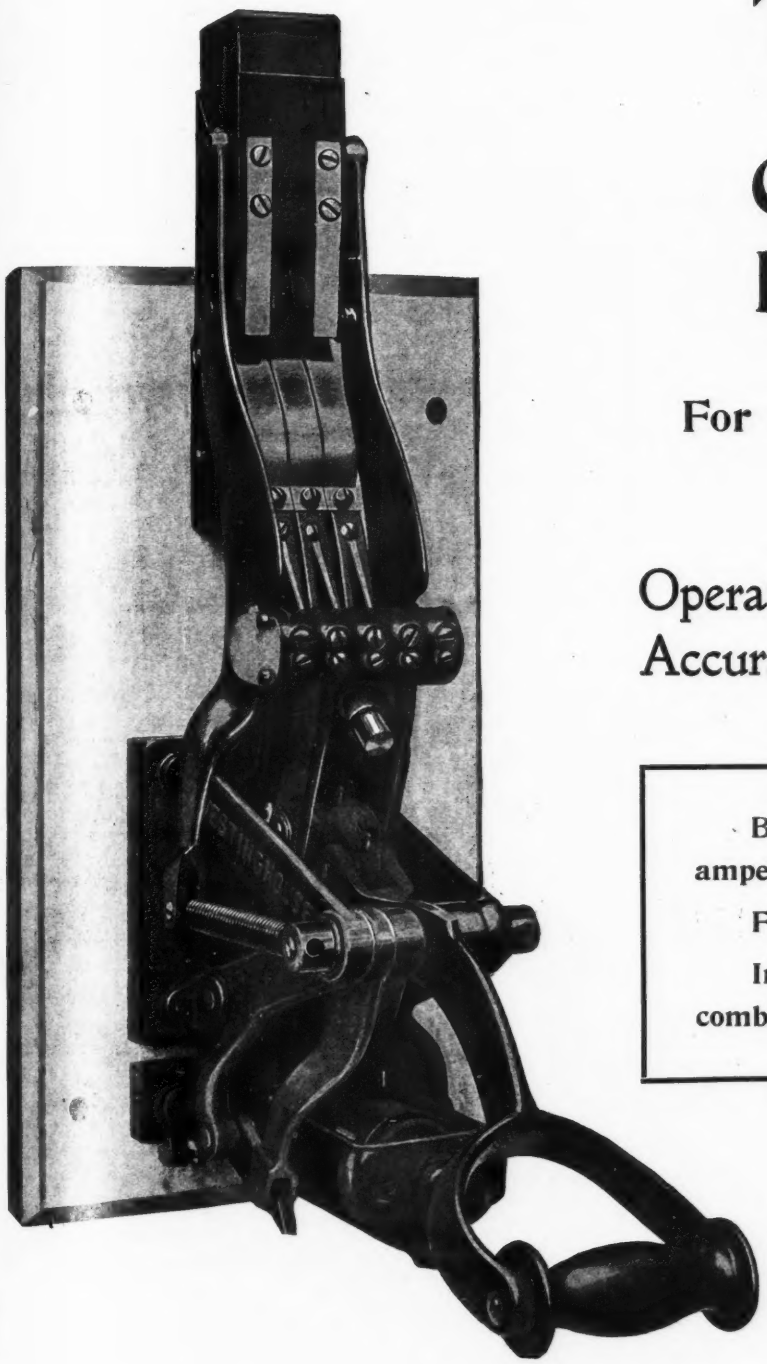

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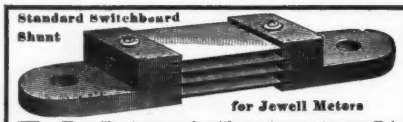

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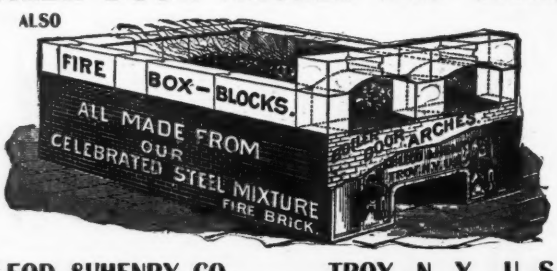

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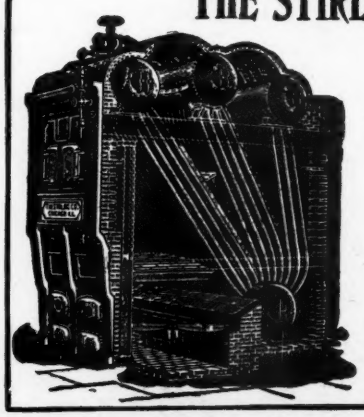

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SEE PAGES 33, 35, 37 and 39

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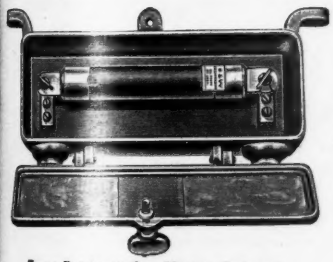

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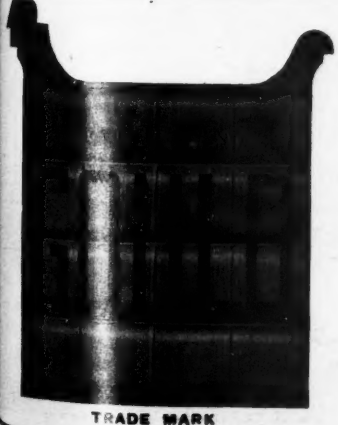

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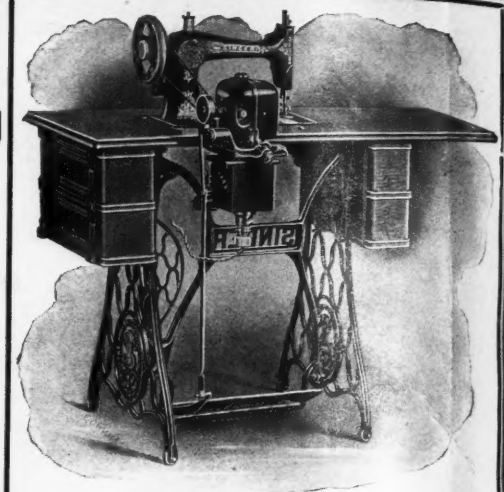

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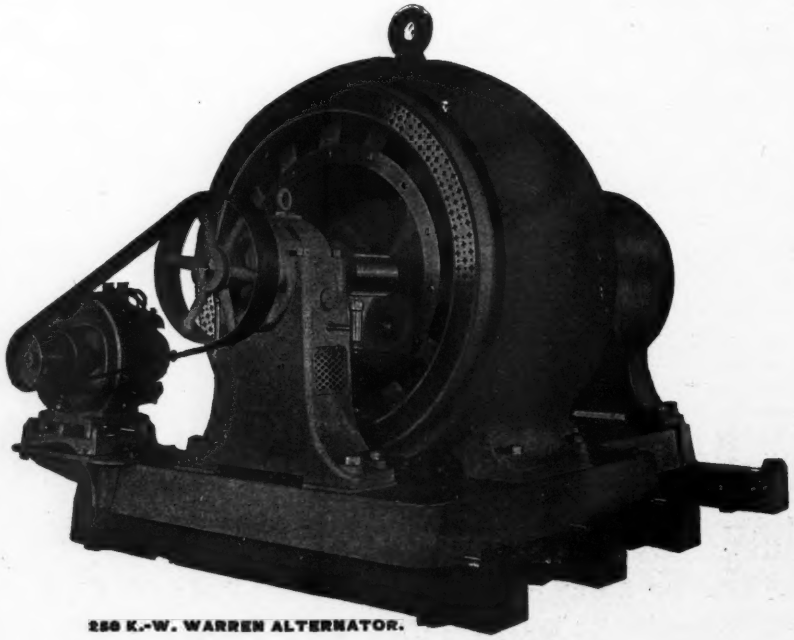

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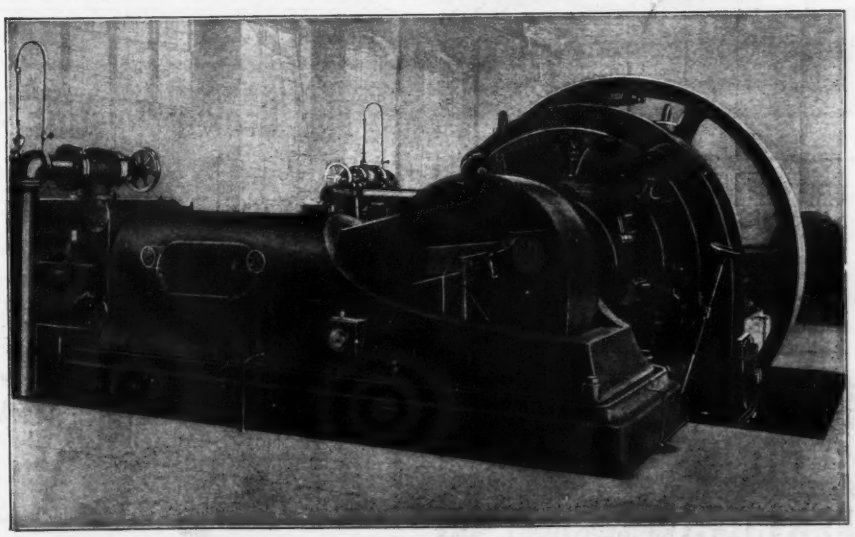

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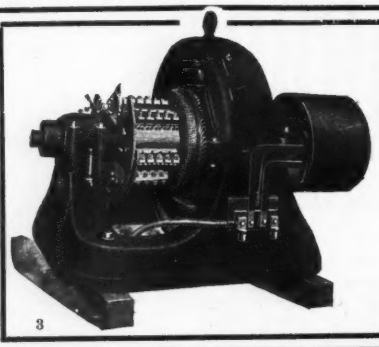

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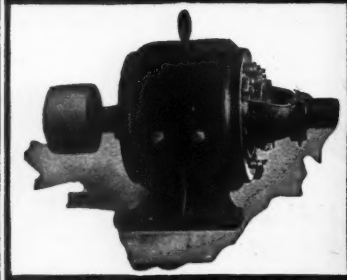

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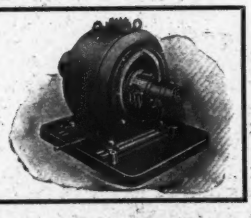

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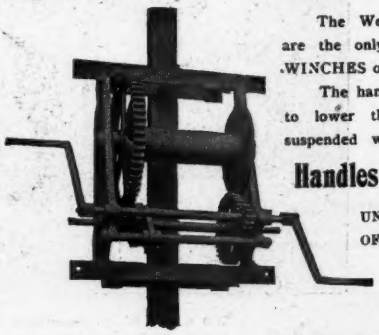

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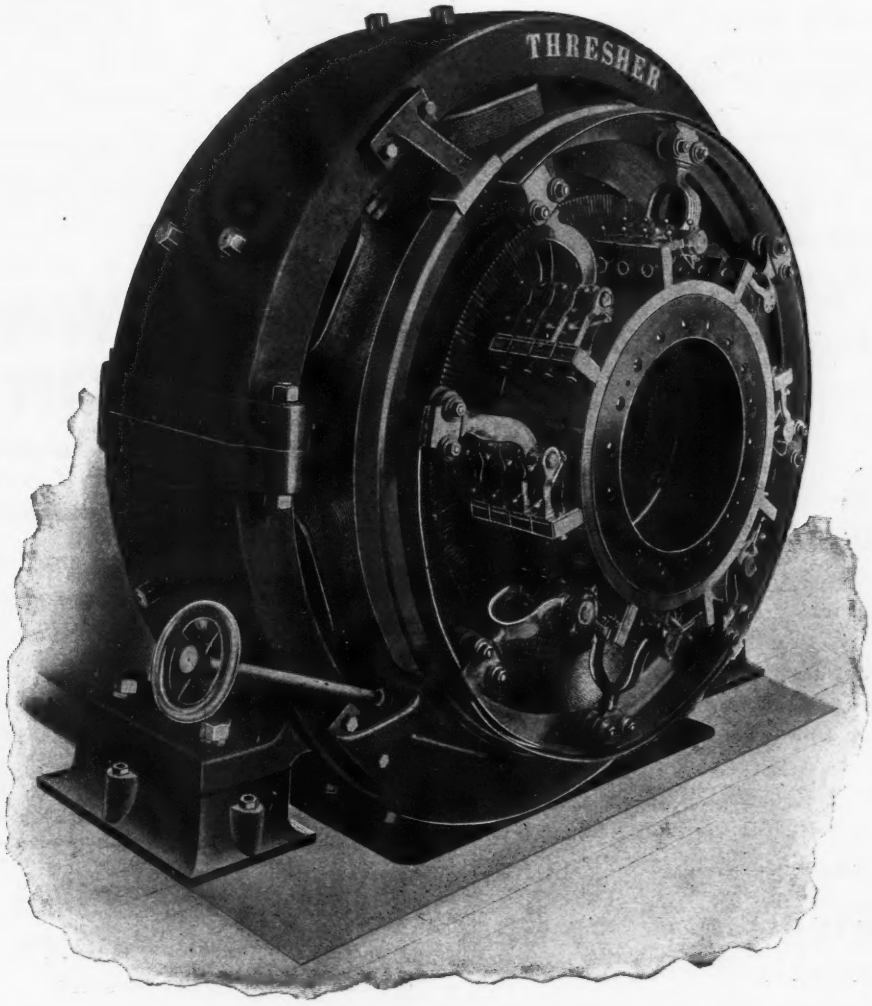

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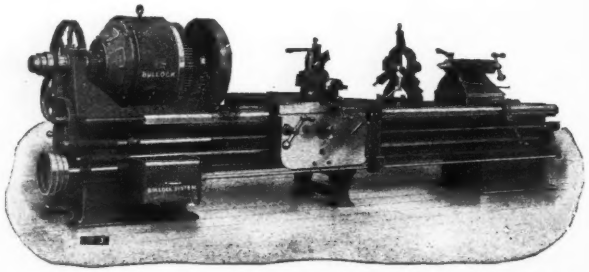

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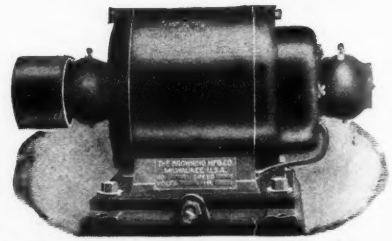

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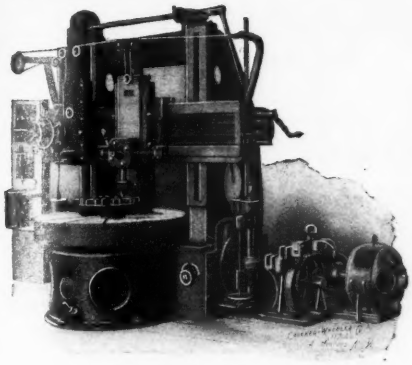

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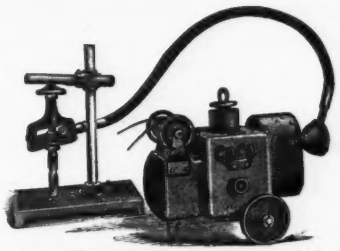

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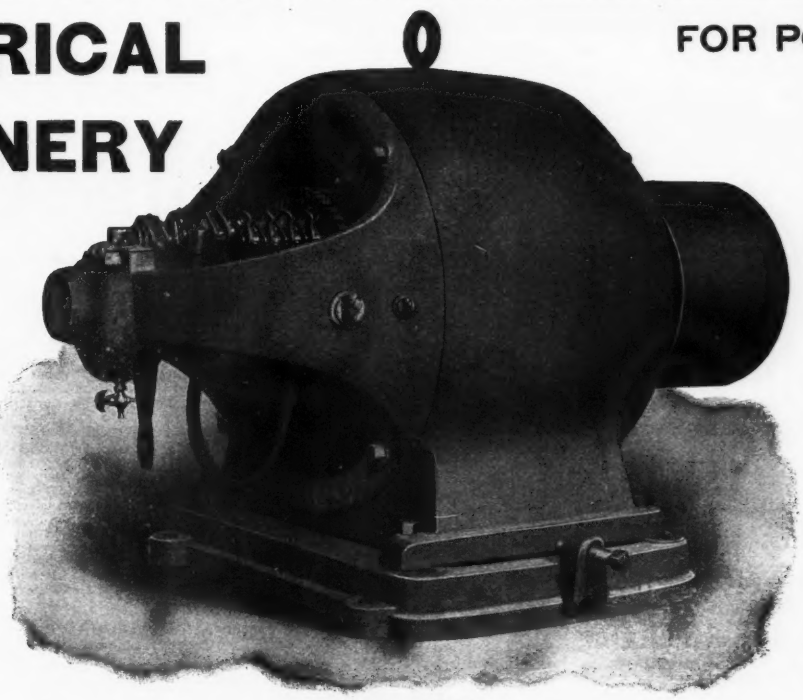

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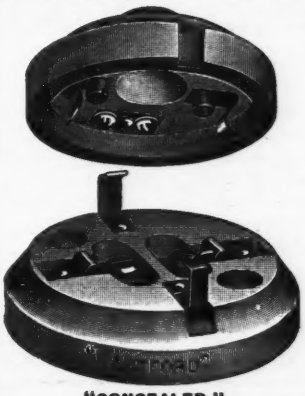

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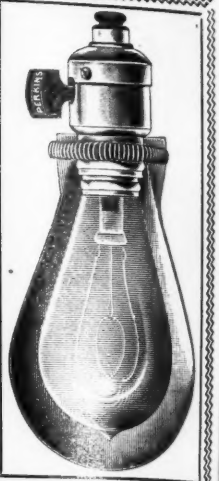

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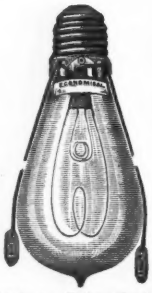

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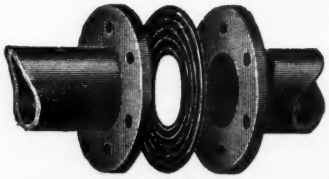

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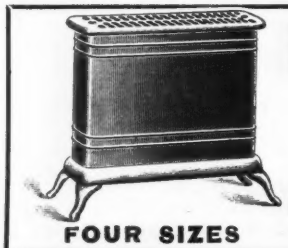

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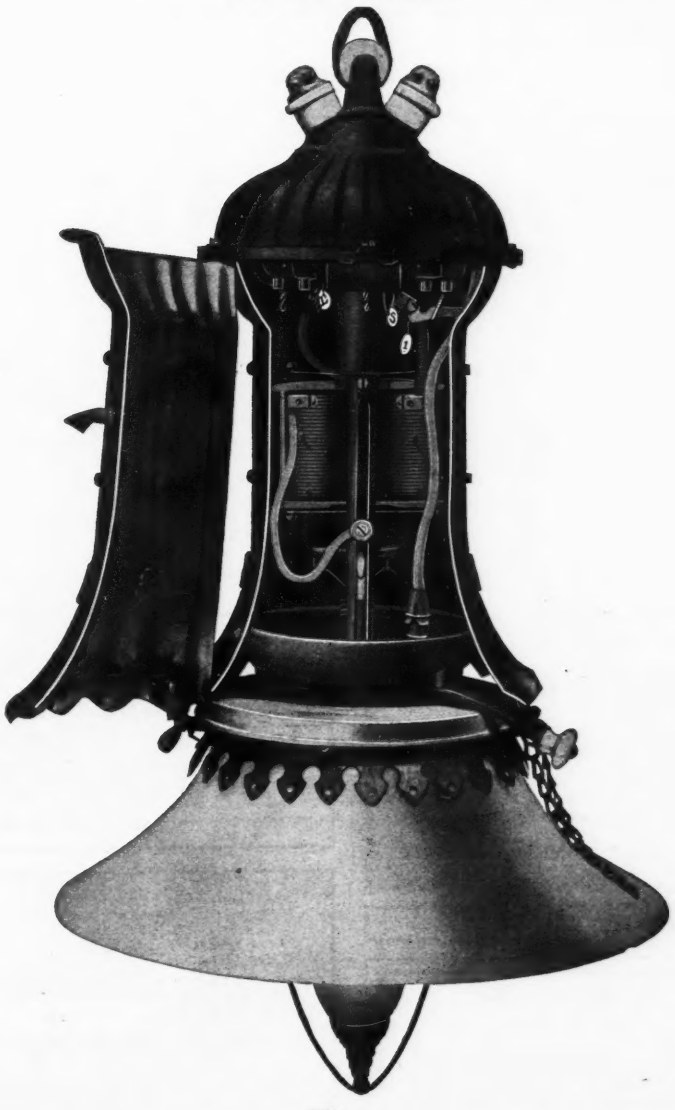

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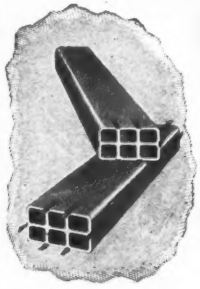

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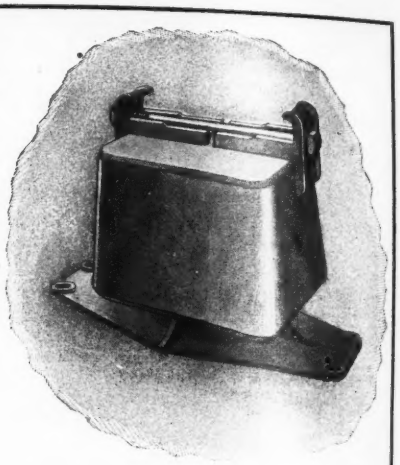

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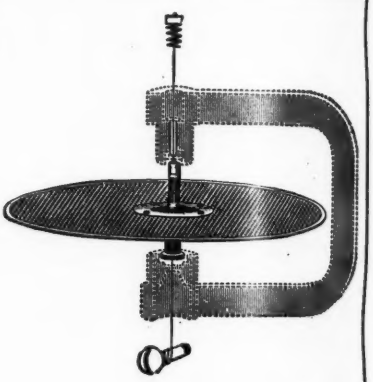

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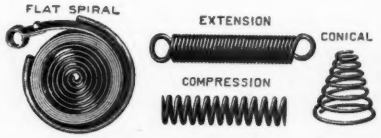

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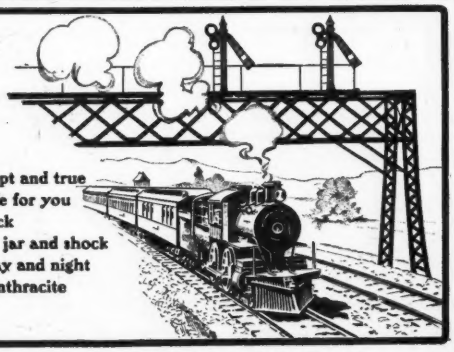

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That make the journey safe for you
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That keeps the trains from jar and shock
That smoothly run both day and night
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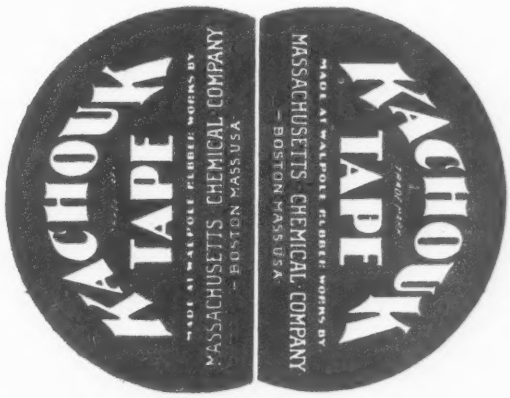
WHY 

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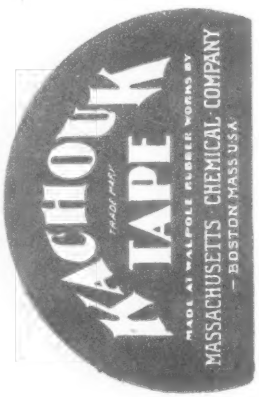

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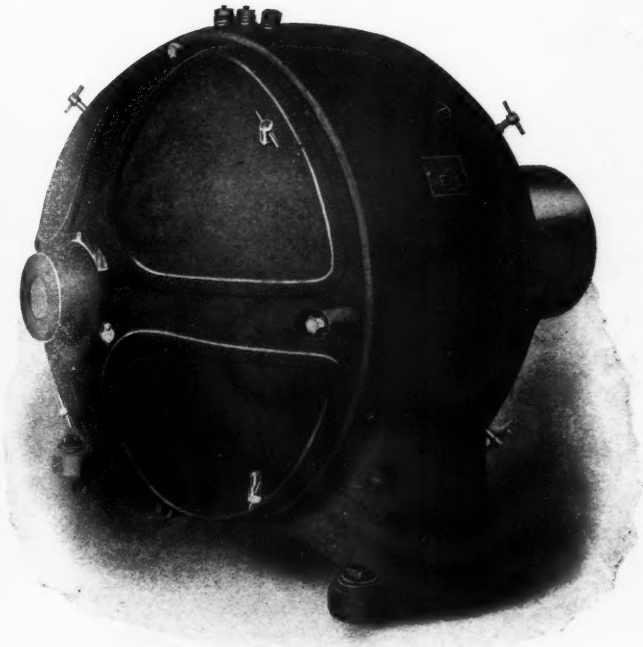

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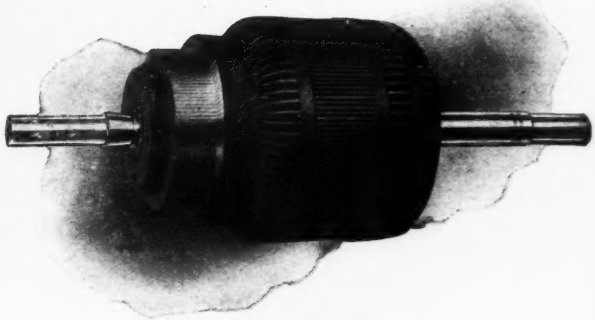

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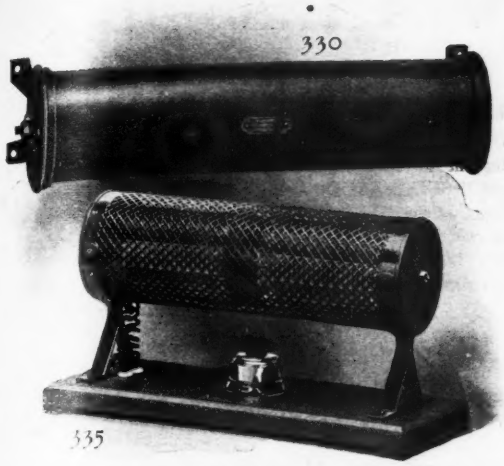

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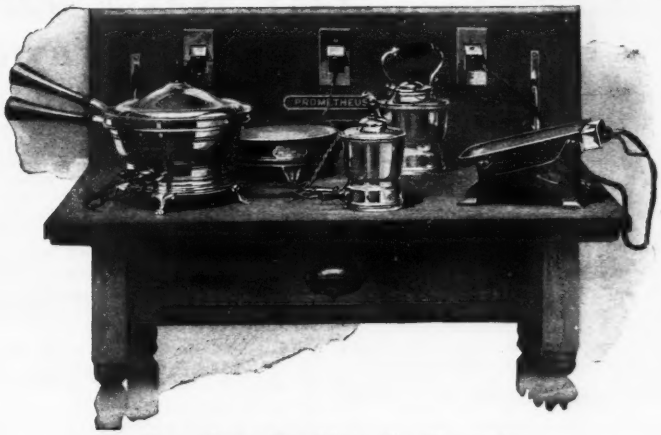

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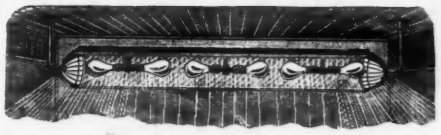

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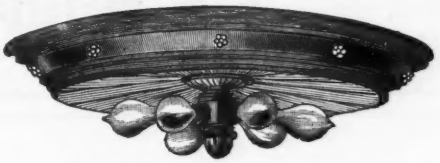

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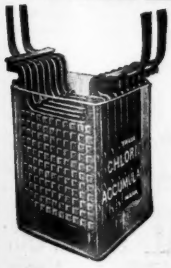

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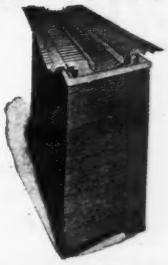

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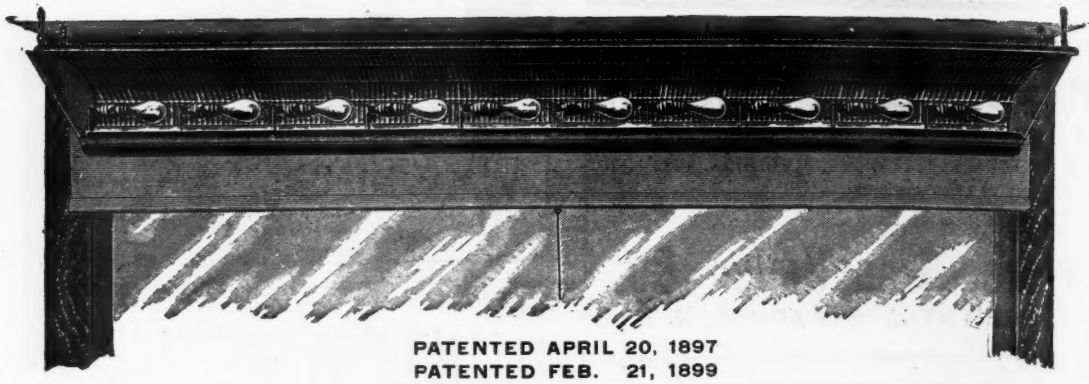

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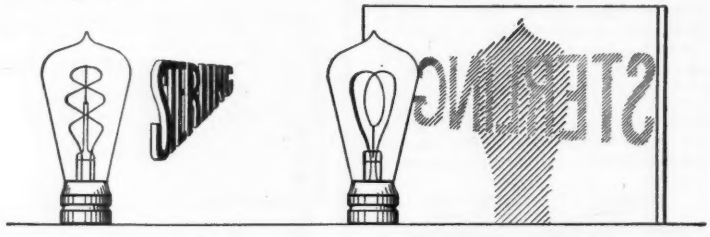

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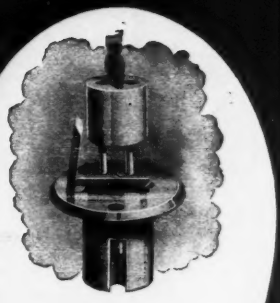

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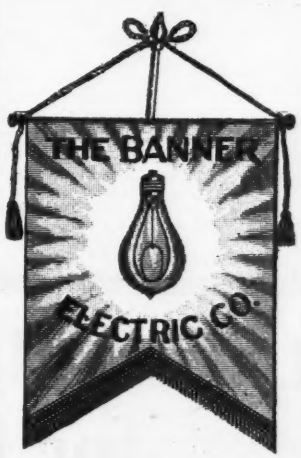

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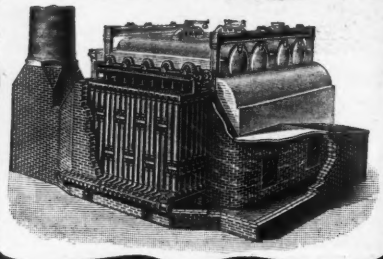

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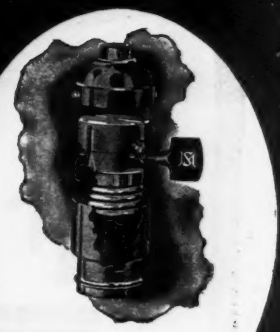

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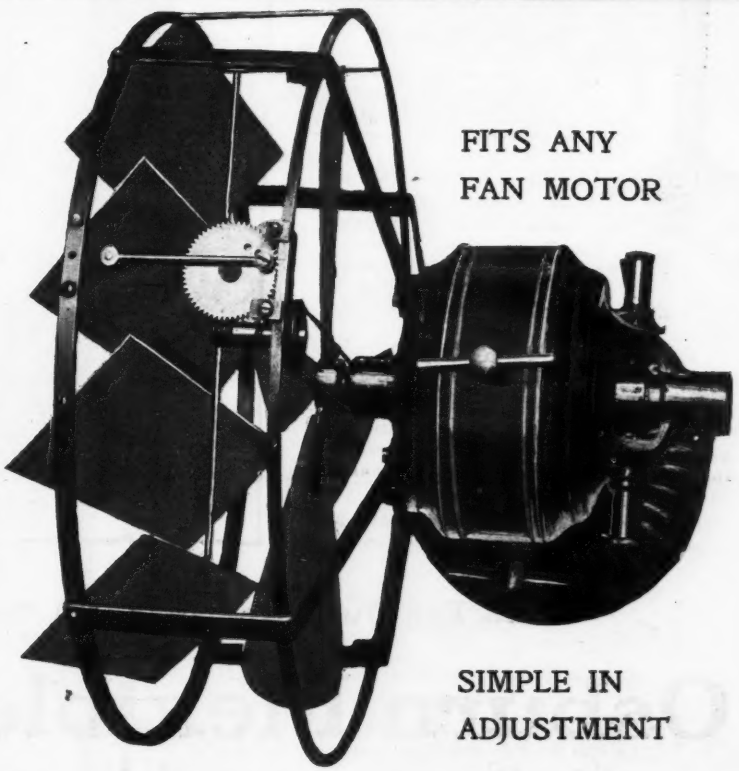

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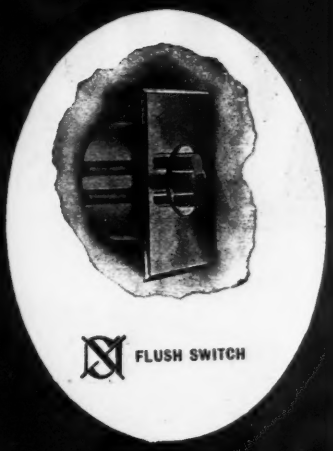

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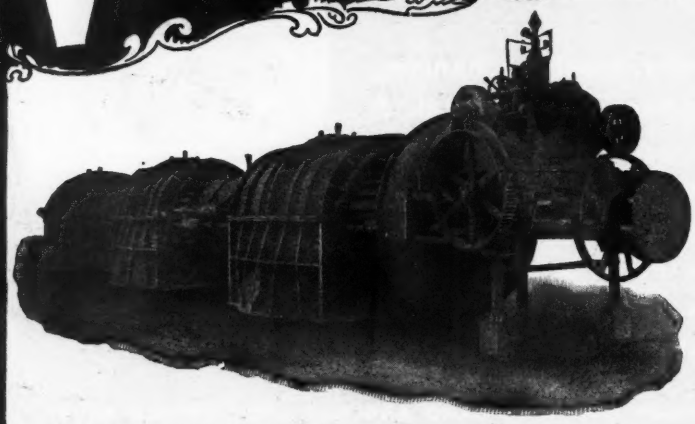

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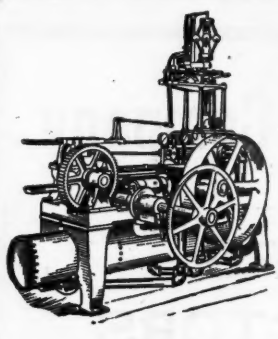

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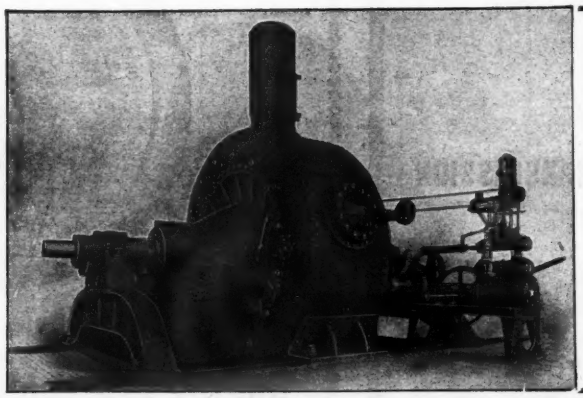

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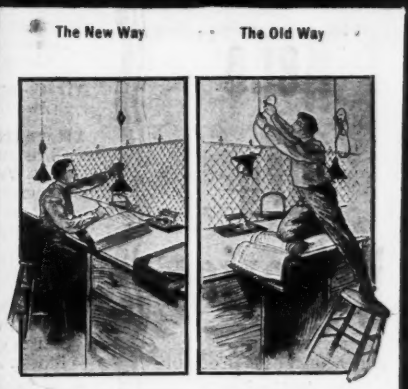

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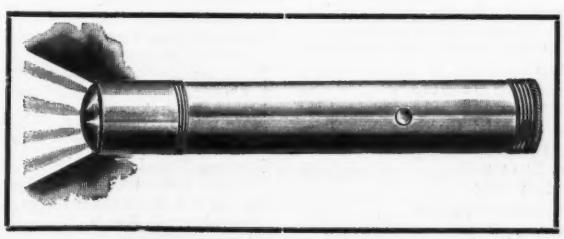

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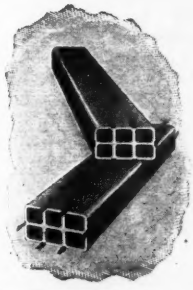

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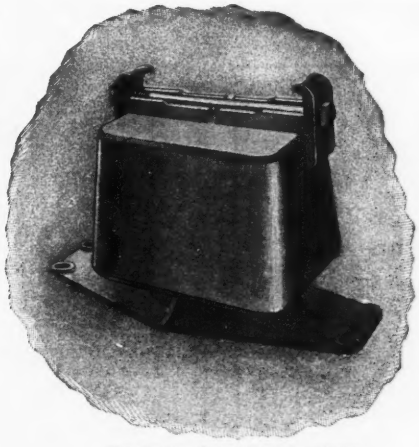

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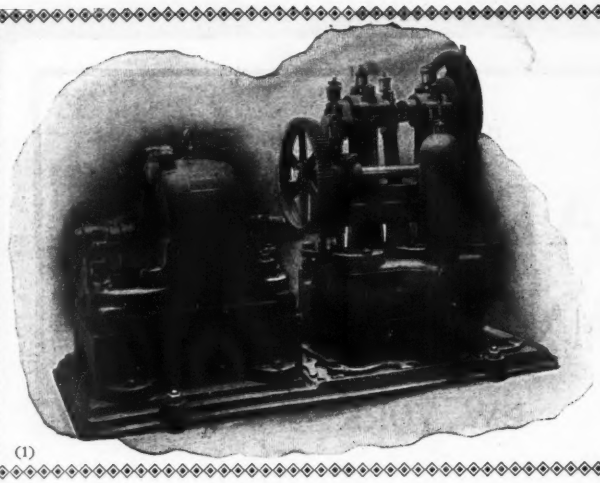

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New York

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Hawkins'
New Catechism of
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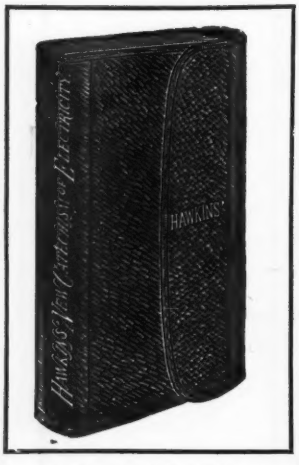

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By depositing ticket with Joint Agent at New Orleans on or before November 18th, and payment of 50 cents, the return limit will be extended to November 30th.

Last of the Season

Niagara Falls

Low-Rate Excursion via Pennsylvania Railroad

The Pennsylvania Railroad Company will run its last popular ten-day excursion for the present season to Niagara Falls from Philadelphia, Baltimore, and Washington on October 16, via Harrisburg and the picturesque valley of the Susquehanna, by special train leaving Philadelphia at 8.10 A. M.

Excursion tickets, good for return passage on any regular train, exclusive of limited express trains, within ten days, will be sold at $10.00 from Philadelphia and all points on the Delaware Division; $11 25 from Atlantic City; $9.60 from Lancaster; and at proportionate rates from other points including Trenton, Bordentown, Mt. Holly, Cape May, Salem, Wilmington, West Chester, Reading, and principal intermediate stations. A stop-over will be allowed at Buffalo within the limit of ticket returning.

The special train of Pullman parlor cars and day coaches will be run through to Niagara Falls. An extra charge will be made for parlor car seats.

An experienced tourist agent and chaperon will accompany each excursion.

For descriptive pamphlet, time of connecting trains, and further information apply to nearest ticket agent, or address Geo. W. Boyd, Assistant General Passenger Agent, Broad Street Station, Philadelphia.

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It's an art to travel, did you ever think of it in that light, and there is as much difference in roads as there is difference in houses. A well kept station, polite and obliging employés, a train which shines inside and out, aisles carpeted, a profusion of light, an agreeable order of architecture in the design of the car, a powerful locomotive able to make and keep on time, a road-bed of heavy iron and rock ballasted, too, and a running schedule fast enough to suit you, all this in addition to a picturesque country to travel through, and you have pretty near a model road. Such are the conditions of the New Jersey Central, which road operates the famous hourly service between New York and Philadelphia, with a train every hour, and on the hour, in both directions.

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A UNIQUE GARDEN SPOT.

After the turmoil of the long summer one instinctively casts about for a winter's abode. A place remote from the whirl of the city where quietness reigns and where the advantages of the metropolis may be had is invariably chosen. The busy man of course wishes to be within hailing distance of New York and just far enough away that the train ride is not tedious. That fashionable winter resort Lakewood, N. J., meets every demand. A ninety-minute journey lands you in Lakewood where your most particular whims are catered to and the conveniences afforded are palatial in every respect. The public schools are model educational institutions and there are also several private schools of reputation. The climate at Lakewood is at least 10 degrees warmer than New York or Philadelphia. The roads for those who enjoy driving or the auto are exceptional. The pine belt in which this charming resort is located is healthful in the extreme, and for social environs Lakewood has no equal.

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for the same price. The new
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IT REPRESENTS IMPERFECT GRINDING

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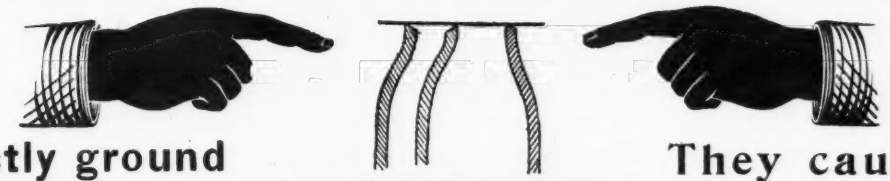
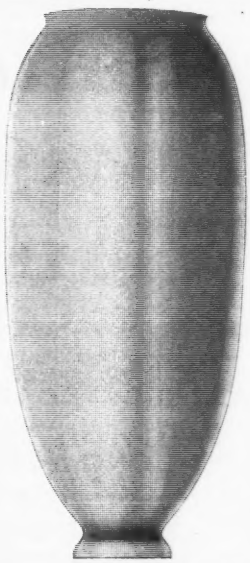


Imperfectly ground edges reduce the life of your carbons five to twenty per cent.

They cause more trouble, waste more light and cost more in the end



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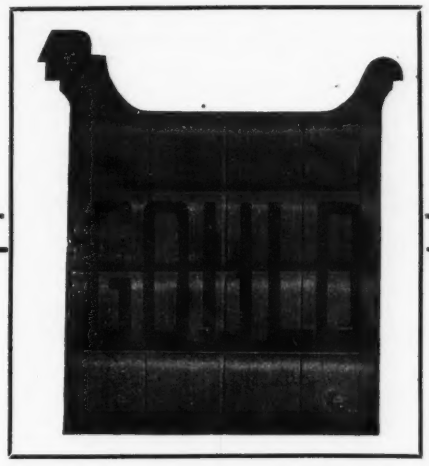

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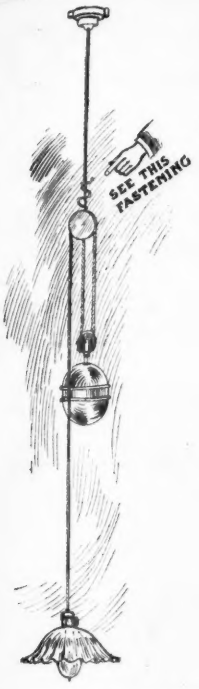

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Price, nickel-plated.....**$2.00**
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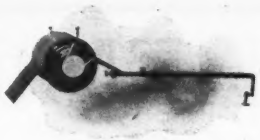
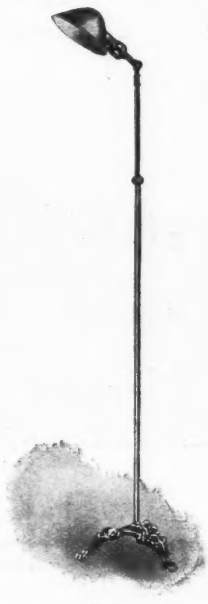


No. 4

No. 4 Adjustable Shade Lamp with desk attachment for roll top desks. Will fit any desk as it is adjustable. Does not prevent the closing of the desk and will not mar the woodwork.

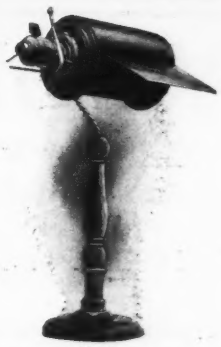
Price, nickel-plated or polished brass arm and frame, tin hood, enameled green....**$3.50**
With nickel-plated or polished brass hood, **3.75**
Weight of lamp, boxed, 1½ pounds.



No. 50

A lamp for general use at the easy chair, bed or sewing table. Fancy enameled iron base and polished brass standard. Can be raised or lowered at will. Height of lamp, three feet. Height of lamp when raised five feet. Has half-ball aluminum shade with joint.

Price of lamp complete. **$5.50**



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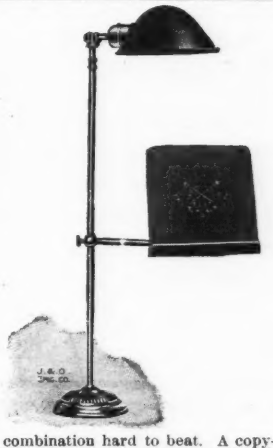

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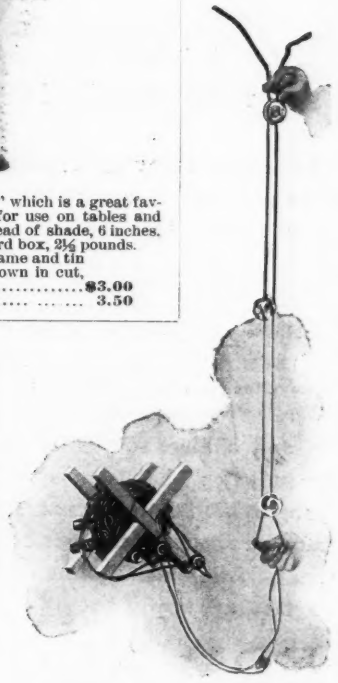

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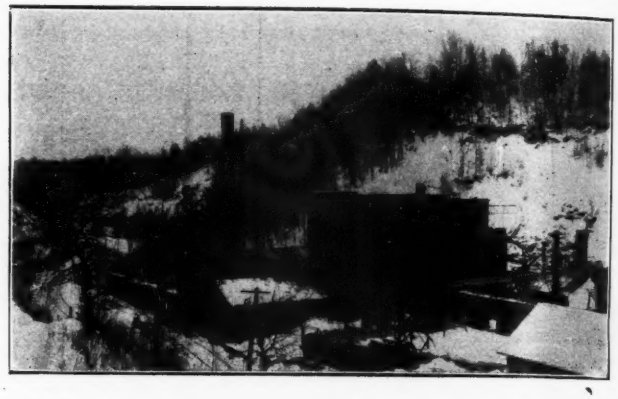

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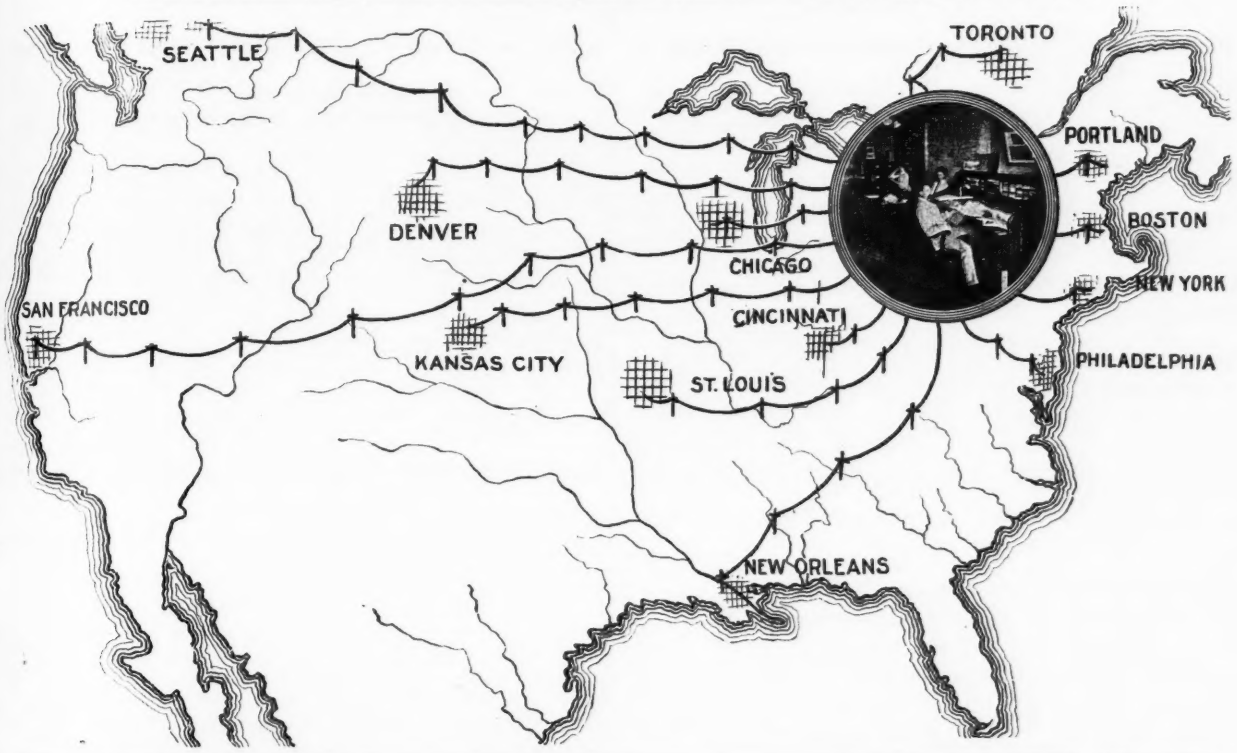

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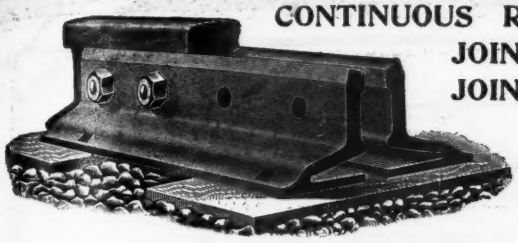

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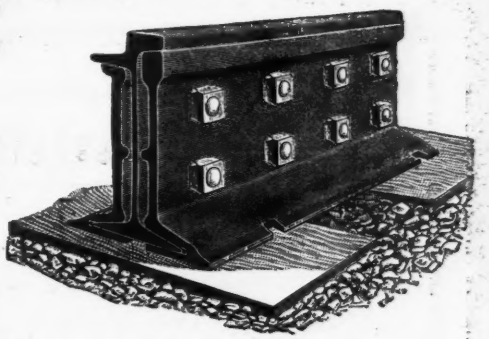

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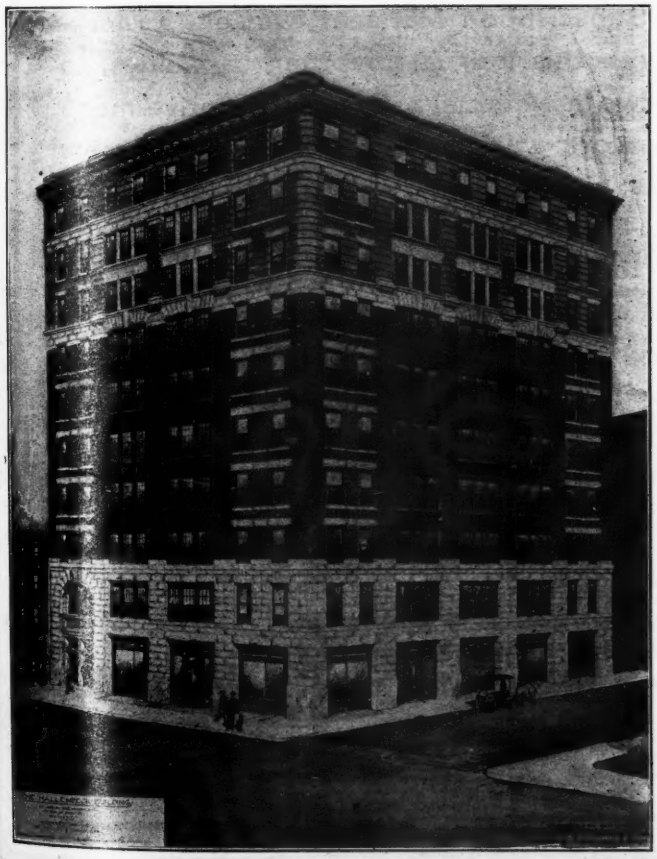

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In the last issue of this journal we used our own advertising space to tell you something of the "personal call" canvass which has been made throughout the United States for new subscribers to the ELECTRICAL REVIEW. Until this moment it has not been our policy to use this information for the purpose of interesting manufacturers who advertise. We now, however, wish to tell you of the elaborate and systematic work which the ELECTRICAL REVIEW has carried on during the last eighteen months for the up-building of its subscription list, which work has placed the ELECTRICAL REVIEW well in advance among engineering publications as to the magnitude of its paid-up cash-in-advance readers.

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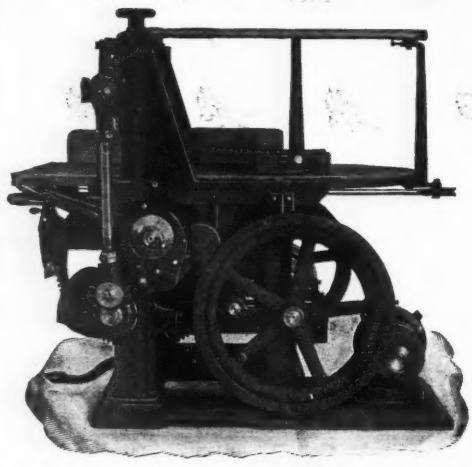

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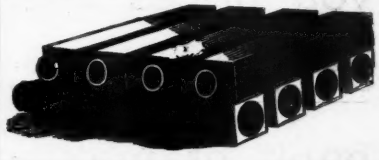

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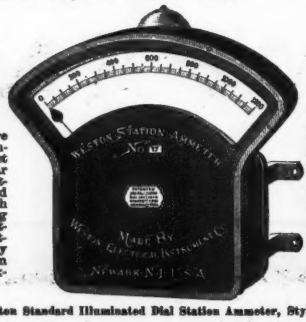

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709,865 Railway switch operating device; J. C. Booth, Monessen, Pa.

709,867 Process of manufacturing nitrogen compounds from atmospheric nitrogen; C. S. Bradley, New York, N. Y.

709,868 Apparatus for subjecting gases to high-tension discharges; C. S. Bradley, New York, N. Y.

709,915 Control of electric motors; H. W. Leonard, Bronxville, N. Y.—Comprises conveying apparatus, two dynamo-electric machines for operating said apparatus, one of said machines operating as a motor to drive the apparatus, and the other machine operating as a generator or driven by said apparatus.

709,916 Method of controlling the electric motors; H. W. Leonard, Bronxville, N. Y.—The method of controlling the tension upon a cableway between two ships at sea, which consists in winding up one end of the cable by means of an electric motor, driving by means of the other end of the cable an electric generator, and controlling the output of said generator.

709,971 Electrolytic decomposition of alkaline salts; E. Edser, London, England.

(Continued on page 60.)

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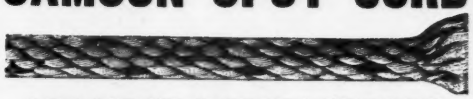
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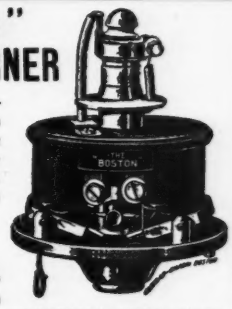
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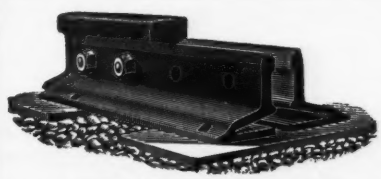
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PATENTS.

(*Continued from page 59.*)

709,996 Signal lamp for telephone switchboards; F. R. McBerty, Evanston, Ill.

710,007 Elevator; J. Rice, Chicago, Ill.

710,045 Electrical steering gear; M. W. Day, Schenectady, N. Y.—In a system of controlling movement at a distance, a generator and a motor in circuit with the armature thereof, manually controlled means for inducing a variable field of force in said generator, and means controlled by the motor for inducing an equally variable opposing field of force in said generator.

710,050 Constant-current transformer; A. R. Everest, Lynn, Mass.

710,052 Apparatus for maintaining uniform resistance in electrical circuits; F. A. Gilbert, Brookline, Mass.—Series and shunt-wound carbon-fed controlling coils, and means including an electromagnet in circuit with the shunt-winding and responsive to increase of voltage at the arc, to increase the effectiveness of the shunt-winding.

710,055 Electric-arc lamp; C. E. Harthan, Lynn, Mass.—A tube, a coil and a spool, both of which surround the tube, and adjusting devices mounted on the spool for centering or adjusting the relation of the tube and the spool.

710,056 Automatic circuit-breaker; C. D. Haskins, Schenectady, N. Y.—An electric circuit, automatic means for mechanically cutting a conductive part thereof upon determinate circuit conditions and means for expulsively extinguishing the arc formed at the cut part.

710,065 Self-restoring telephone; J. J. Loeffler, New York, N. Y.

710,067 System of electrical distribution; A. D. Lunt, Schenectady, N. Y.

710,068 Method of maintaining uniform resistance in arc-lamp circuit; E. O. Lundin, Boston, Mass.

710,070 Apparatus for multirate metering; E. Oxley, Lynn, Mass.

710,071 Lock; W. R. Paige, Chicago, Ill.

710,072 Electric railway system; W. B. Potter, Schenectady, N. Y.

710,081–082 System of electrical distribution; C. P. Steinmetz, Schenectady, N. Y.

710,083 Electric meter; G. Stern, Charlottenburg, Germany.

710,096 Electric controller; W. A. Carrell, West Homestead, Pa.

(*Continued on page 62.*)

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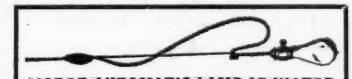
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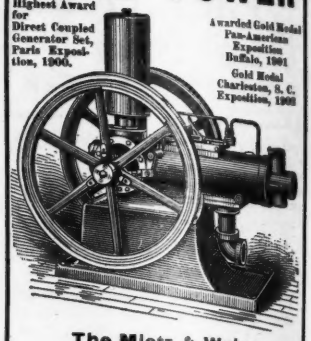
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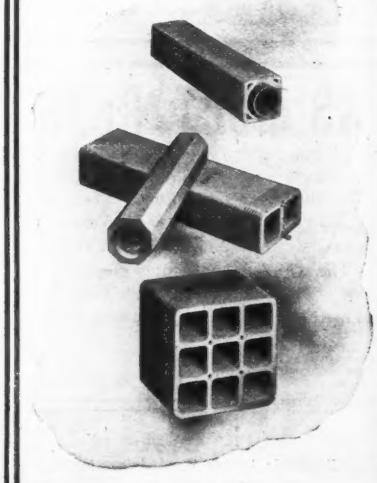
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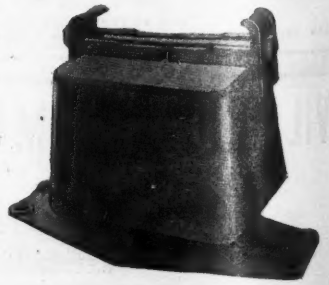
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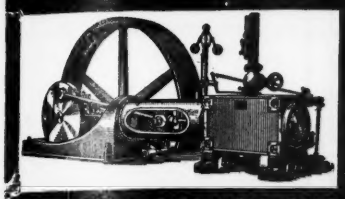

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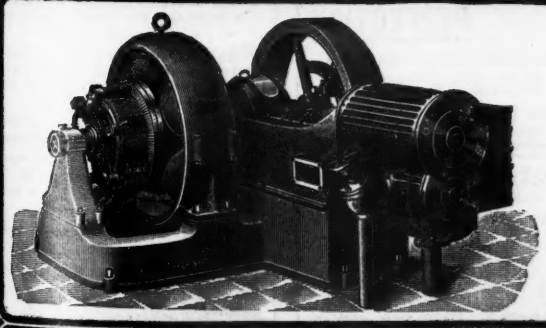

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(*Continued from page 60.*)

710,099 Method of exhausting incandescent electric lamps of relatively low voltage; S. E. Doane, Marlboro, Mass.

710,121 - 122 Wireless telegraph system; H. Shoomaker, Philadelphia, Pa.

710,143 Resistance coil and support therefor; H. P. Davis, Pittsburg, Pa. —A resistance element comprising two rings of different diameter located in parallel plains and connected by a plurality of parallel arms and insulating blocks severally located between said pairs of arms.

710,146 Automatic electric time switch; H. K. Gardner, Providence. R. I.

710,158 System of electrical distribution; B. G. Lamme, Pittsburg, Pa.

710,163 Keyboard perforator; D. Murray, New York, N. Y.

710,186 Method of exhausting incandescent electric lamps; S. E. Doane, Marlboro, Mass.

710,188 Electric switch; B. J. Foley, Pittsburg, Pa.

710,216 Insulating hanger; J. M. Schmidt, Elkhorn, W. Va.

710,246 Telegraph fire hose; J. Buchtel, Portland, Ore.

710,257 Magnetic drilling jig; A. L. De Leeuw, Hamilton, Ohio.

710,264 Electrical typewriter; C. Gibbs, New York, N. Y.

710,270 Electric switch; F. H. Headley, St. Austell, England.

710,278 Electric battery; T. H. Klinker, Jr., Jersey City, N. J.

710,282 Insulator; E. Lefever, Climax, Ohio.

710,297 Insulator; R. S. Peirce, Chicago, Ill.

710,309 Telephone transmitter; M. Weisser, Milwaukee, Wis.

710,311 Electromagnetic device for controlling the rotation of shafts; P. V. Avril, Paris, France.

710,318 Toll apparatus for telephone exchanges; W. W. Dean, Chicago, Ill.

710,320 Signaling apparatus; H. A. Fessenden, Detroit, Mich.

710,333 Selective calling appliance for telephone lines; F. R. McBerty, Chicago, Ill.—Two ringing keys and pivoted switch levers thereof, a pivoted arm, a target or indicator carried thereon, and links between the said switch levers and the said target lever, whereby the target is set in a different position in the movement of each of the keys.

710,335 Selective call for telegraph or telephone lines; Wm. Palmer, Jr., Rincon, N. Mex.

710,346 Electrometallurgic treatment of ores; C. J. Tossizza, Paris, France.

710,348 Electrical system of recording and checking as applied to railway signaling; W. H. M. Weaver, Macon, Ga.

710,354-355 Wireless telegraph system; C. D. Ehret, Rosemont, Pa.

710,356 Circuit-breaker for electric-lamp glowers; F. M. Goddard, Pittsburg, Pa.

710,363 Method of starting rotary converters; B. G. Lamme, Pittsburg, Pa.

710,367 Circuit-breaker; C. J. Reed, Philadelphia, Pa.

710,369 Electric lamp glower and method of attaching terminal wires thereto; E. R. Roberts, Bellevue, Pa.

710,372 Decoherer; H. Shoemaker, Philadelphia, Pa.

710,373 Interrupter for electric apparatus; H. Shoemaker, Philadelphia, Pa.

710,374 Electric arc lamp; A. F. Shore, New York, N. Y.

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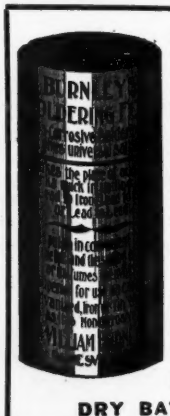
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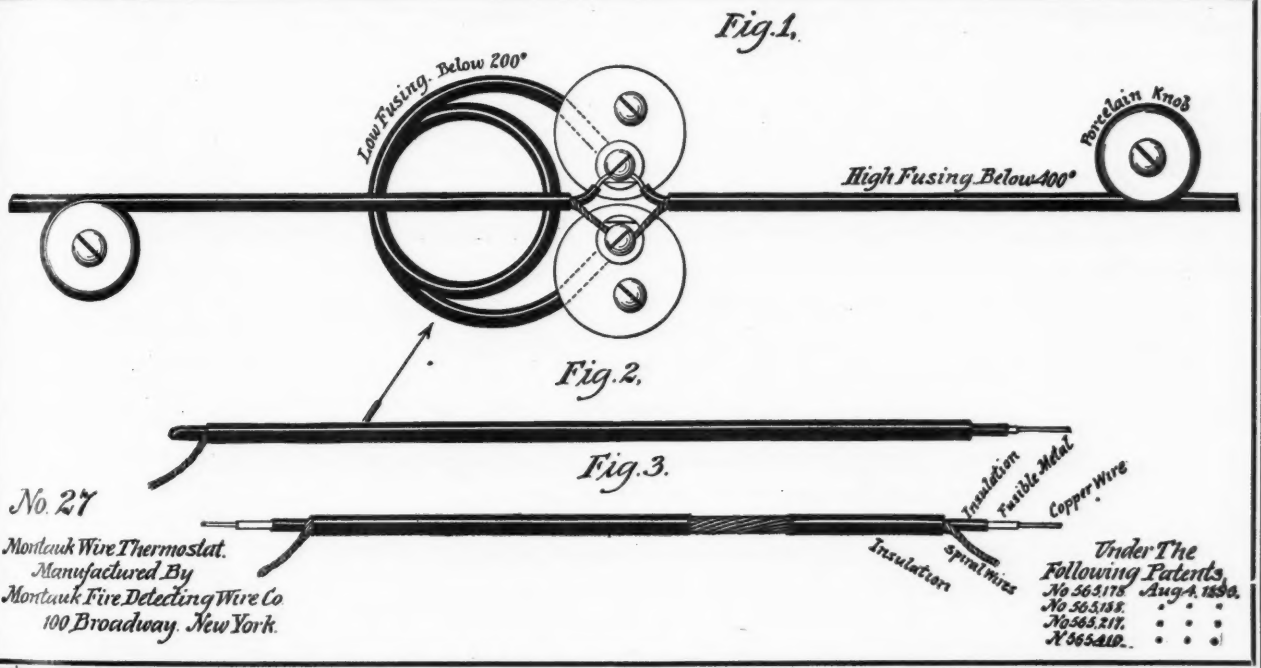

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1—2-H.-P. Belknap.
1—2-H.-P. General Electric.
1—¼-H.-P. Detroit.

BELTED DYNAMOS AND MOTORS 220 VOLTS

1—240-kw. M. P. Walker.
2—80-kw. M. P. C. & C.
1—75-H.-P. M. P. C. & C.
1—56-kw. Westinghouse M. P.
1—D62-kw. Thomson-Houston.
1—D20-kw. Thomson-Houston.
1—40-H.-P. Hobart.
1—25-H.-P. C. & C.
1—25-H.-P. Eddy.
1—15-H.-P. Perret.
1—15-H.-P. Excelsior.
1—12-H.-P. C. & C.
1—10-H.-P. Thomson-Houston.
1—8½-kw. Edison.
1—8-kw. Mather.
1—8-H.-P. Excelsior.
1—3-H.-P. Exceisoir.
1—2½-H.-P. Ft. Wayne.
1—15-kw. Siemens & Halske, for direct connection.

BELTED DYNAMOS AND MOTORS 110 VOLTS

2—100-kw. Edison.
1—100-kw. Westinghouse M. P.
2—75-kw. M. P. Westinghouse.
2—60-kw. Edison.
1—45-kw. Edison.
3—30-kw. Edison.
1—25-kw. Edison.
1—50-kw. Siemens & Halske.
1—30-H.-P. U. S.
1—30-H.-P. Westinghouse M. P.
2—35-kw 6 Pole Lundell.
1—15-H.-P. Excelsior.
1—15-H.-P. Mather.
1—10-H.-P. M. P. Excelsior.
1—10-H.-P. Bipolar Excelsior.
1—5-H.-P. Thomson-Houston.
1—25-Amp. Westinghouse.
5—1¼-H.-P. M. P. Excelsior.
1—10-Amp. Westinghouse.
1—3-kw. Mather.
1—21-Amp. Ft. Wayne.
1—2-H.-P. Excelsior.

ALTERNATORS

(SINGLE PHASE.)

1—375-kw. G. E., Class 80-375-90-2,300 volts, 60-cycle, direct-connected to a 20 and 36x48 Cross Compound, E. P. Allis Tangye Frame Engine.
1—250-kw. Westinghouse, 1.100 volts, 120-cycle.
2—150-kw. Ft Wayne, 1,040 volts, 120-cycle, 700 R. P. M.
2—A120 General Electric, single-phase, 1,000 volts, 16,000 alternations.
1—120-kw. Westinghouse single-phase, 2,000 volts, 16,000 alternations.
1—120-kw. Westinghouse, 1.100 volts, 16,000 alternations, toothed arm.
2—A100 T.-H., single-phase, 1,100 volts, 16,000 alternations.
1—100-kw. Ft. Wayne, 2,200 volts, 16,000 alternations.
3—70-kw. T.-H., self-oiling, 120-cycle, 1,050 volts.
2—60-kw. General Electric, single-phase, 1.100 volts, 16,000 alternations.
2—60-kw. Westinghouse, single-phase, 16,000 alternations, 1.100 volts.
1—45-kw. Westinghouse, 2,200 volts, 16,000 alternations.
1—45-kw. Westinghouse, 2,200 volts, 7,200 alternations.
1—45-kw. Westinghouse, 1,100 volts, 7,200 alternations.
2—A35 General Electric, single-phase, 16,000 alternations, 1,050 volts.
2—A30 General Electric, single-phase, 16,000 alternations, 1 050 volts.
1—30-kw. Westinghouse, 1.100 volts, 16,000 alternations.

ALTERNATORS

(TWO AND THREE PHASE.)

1—600-kw. 60-cycle, 3-phase Westinghouse, direct-connected to 23x42 St. Louis Corliss Engine.
1—650-kw. 2-phase Stanley, 133-cycle, 1,200-2,400 volts.
2—250-kw. General Electric. type A. T. B., 16-250-450, 3-phase, 60-cycle, 10,000 volts.
2—325-kw. 2-phase Stanley, direct-connected to Tandem Compound Russell Engines, condensing.
1—150-kw. Monocyclic, 3-phase, 60-cycle, 2,200 volts.
1—150-kw. General Electric, monocyclic, 2,200 volts 120-cycle, complete.
1—150-kw. Stanley, 2-phase, 1 000-2 000 volts, 120-cycle.
1—120-kw. General Electric, 2-phase, 60-cycle, 2,200 volt.
1—75-kw. Stanley, 2,000-1,000 volts, 2-phase, 16,000 alternations.
1—75-kw. General Electric, 2-phase, 60-cycle, 2,200 volts.
1—75-kw. Westinghouse, 2-phase, 60-cycle, 2 200 volts.

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2—165-light, multi-circuit Brush, No. 12 6.8-amp.
3—125-light, multi-circuit Brush, 2,000 C. P. No. 11.
1—120-light, multi-circuit Brush, 1,200 C. P. No. 9.
2—80-light, multi-circuit Brush, 2,000 C. P. No. 9.
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5—M. D. 2, 50-light, Thomson-Houston arc dynamos.
2—L. D. 12, 50-light, Thomson-Houston arc dynamos.
4—M. 2, 45-light, Thomson-Houston arc dynamos.
3—No. 8, 65-light, 2,000 candle-power Brush.

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2—175-H.-P. Stirling Boilers.
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1—18 & 30x16 Vertical Compound Westinghouse.
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1—15½x16 N. Y. Safety.
1—14x16 N. Y. Safety.
1—13x15 Buckeye Auto.
1—13x14 Watertown.
1—9x12 Buckeye.
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2—150 kw., 6-pole, Westinghouse
1—180 kw., 4-pole, Westinghouse
2—110 kw., 4-pole, Eddy
3—100 kw., 4-pole, General Electric
1—100 kw., 4-pole, Walker
1—100 kw., Bipolar Edison
1—90 kw., 4-pole, Thomson-Houston
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1—D62, Thomson-Houston
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1—120 kw., General Electric, 1,000 Volts, Single-Phase
1—120 kw., General Electric, 2,000 Volts, Single-Phase
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1—60 kw., General Electric, 1,040 Volts, Single-Phase
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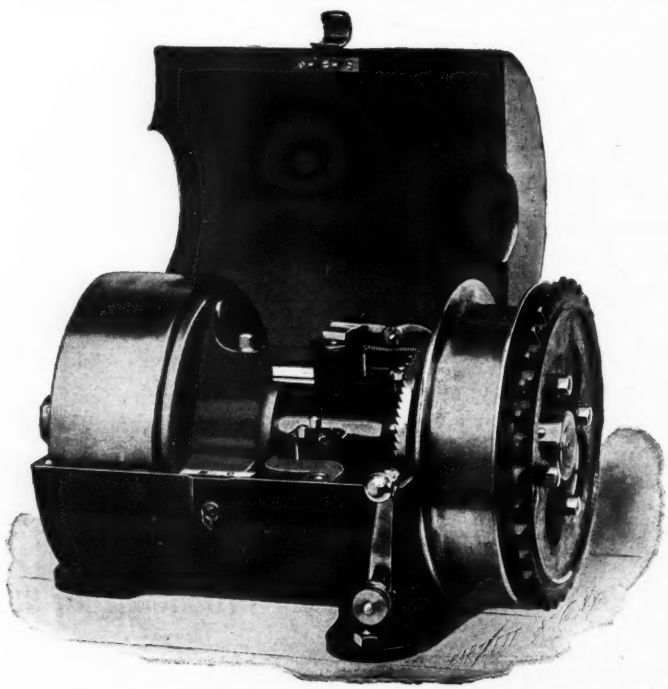

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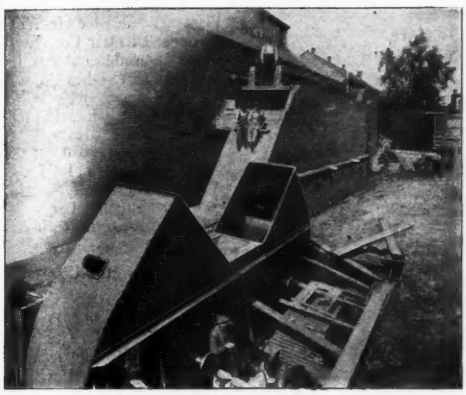

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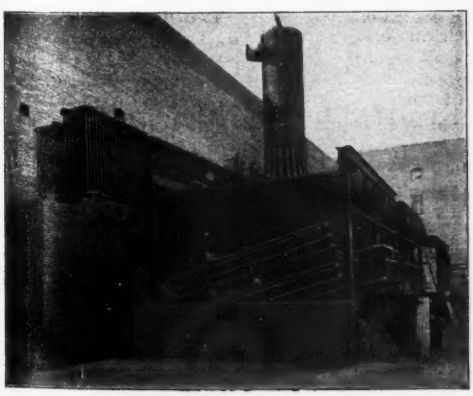

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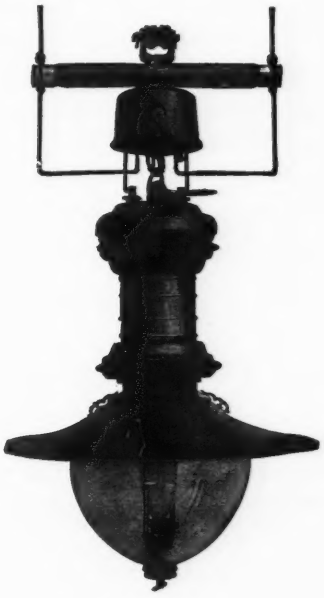

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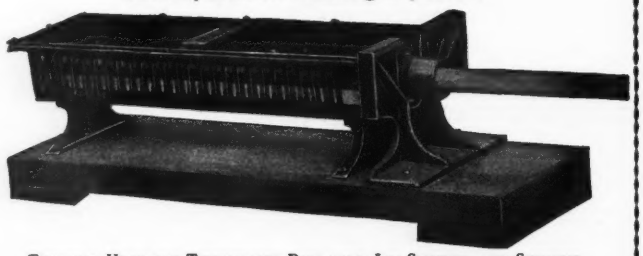

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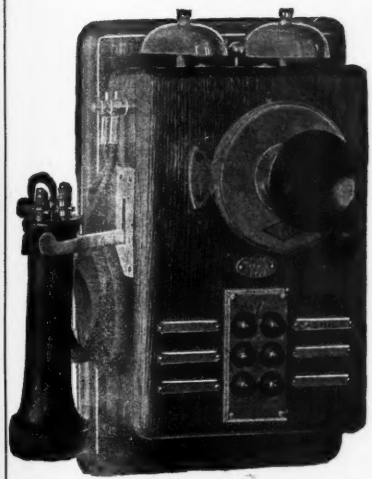

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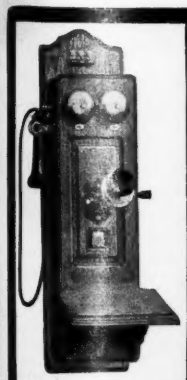

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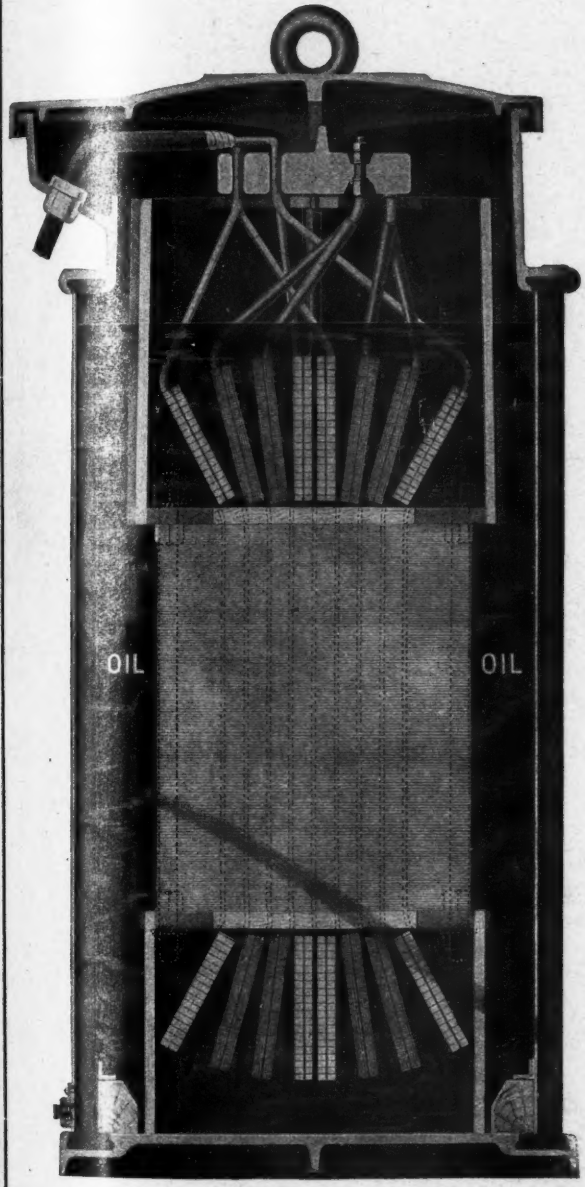

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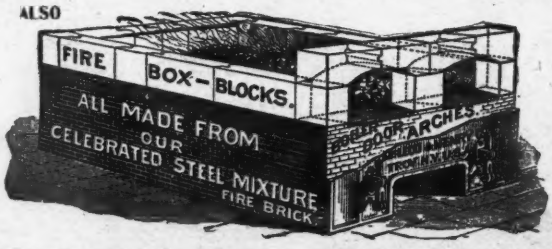

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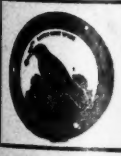
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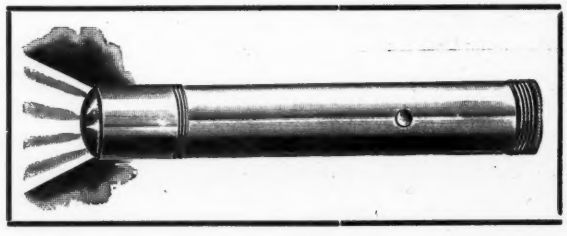

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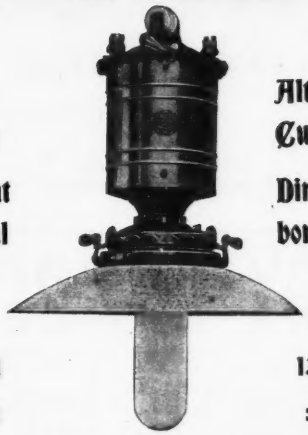

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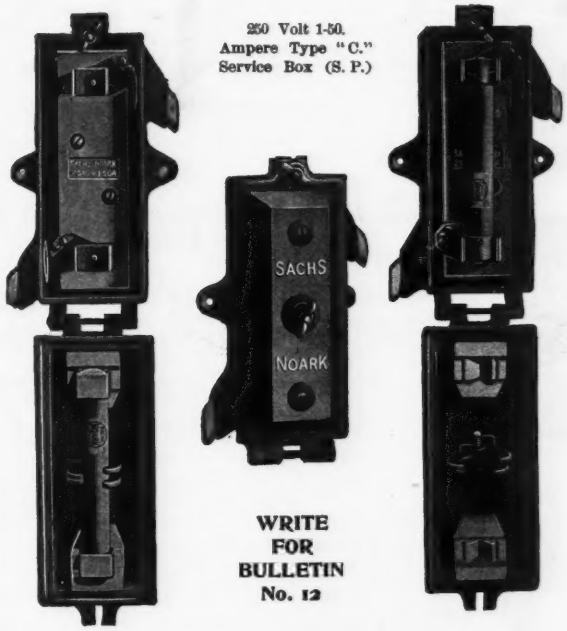

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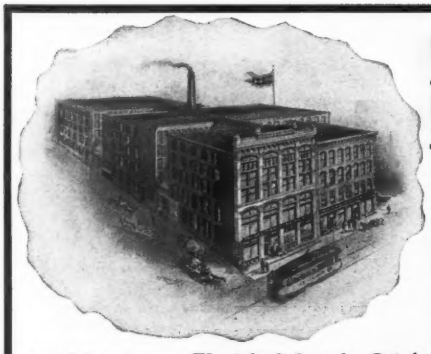

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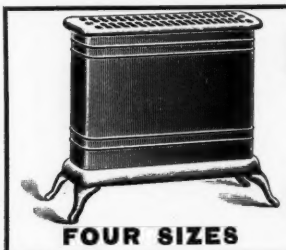

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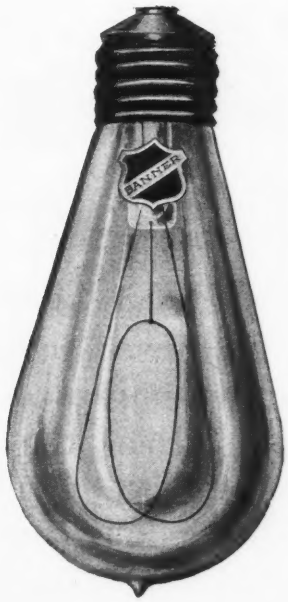

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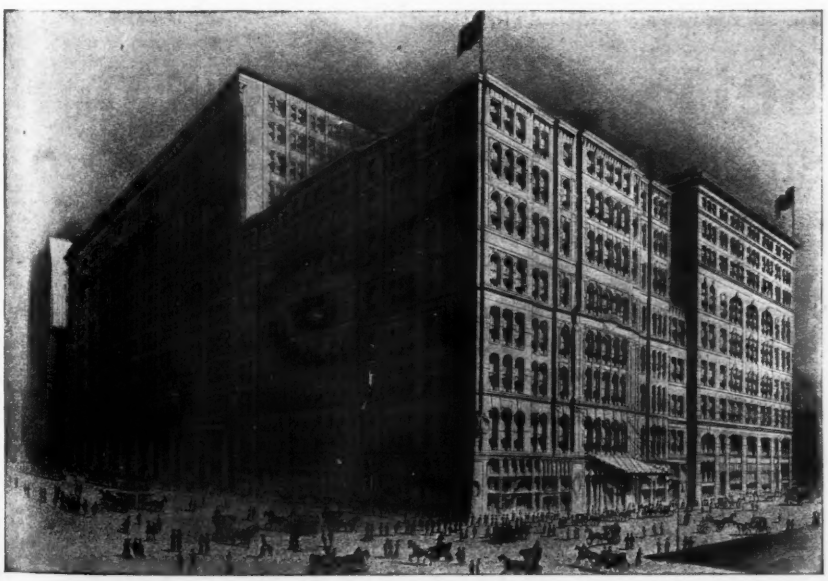

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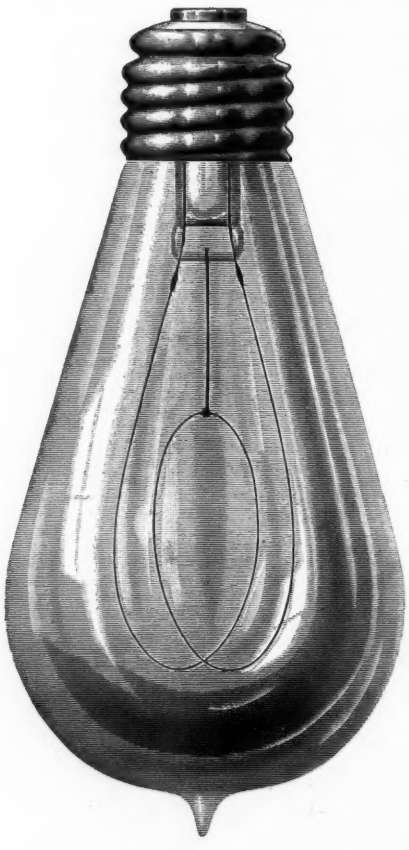

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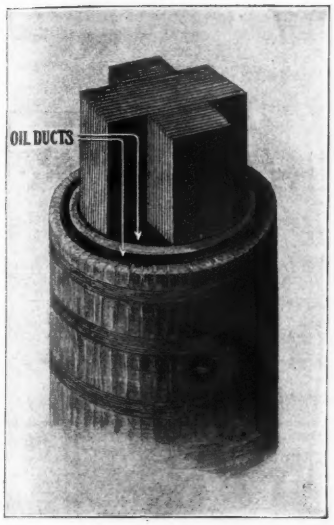

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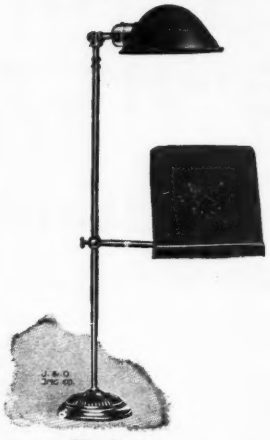

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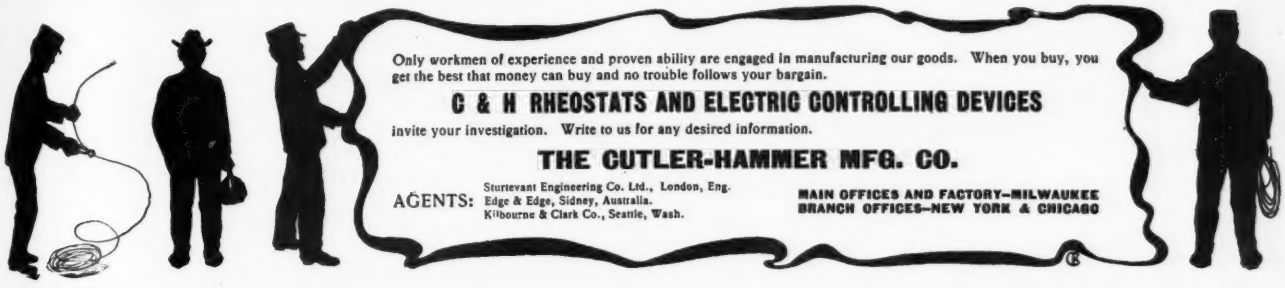

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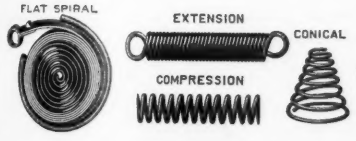

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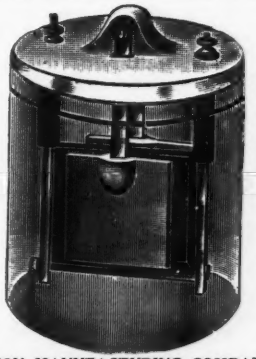

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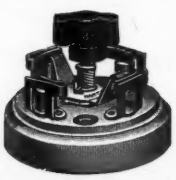

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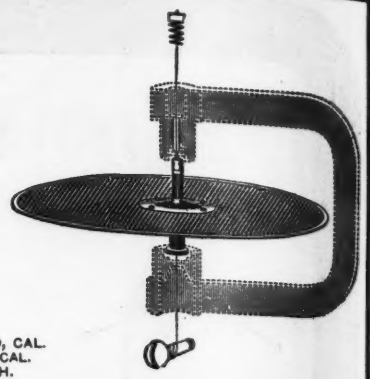

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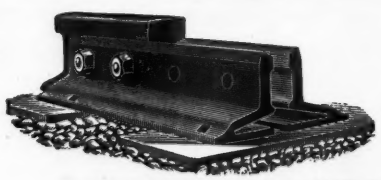

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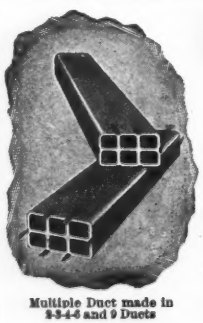
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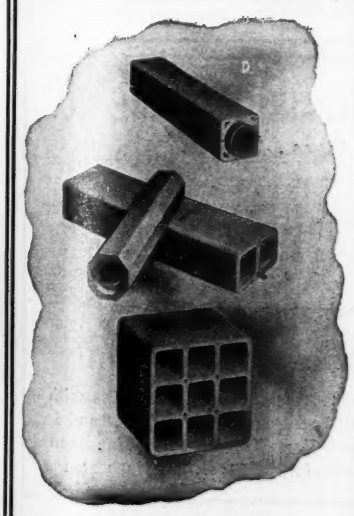

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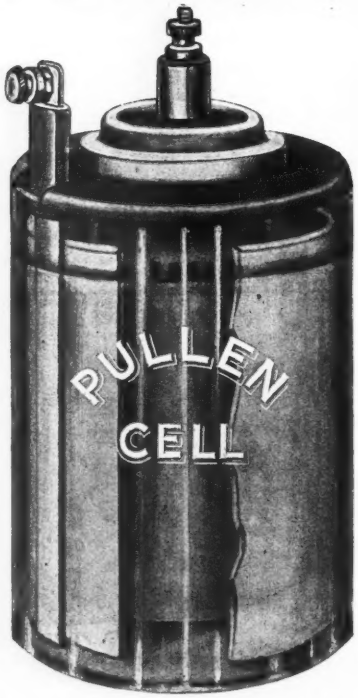

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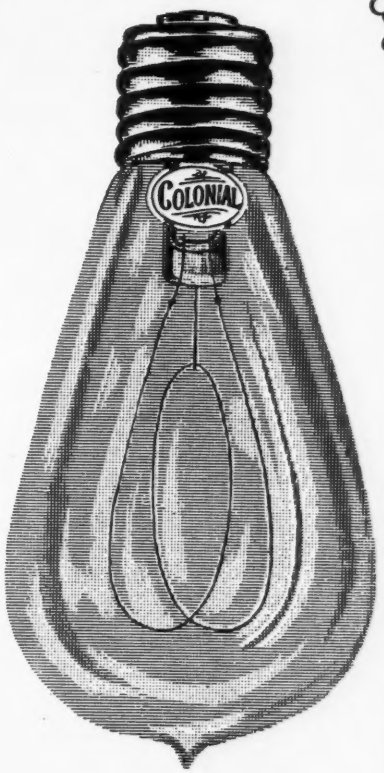

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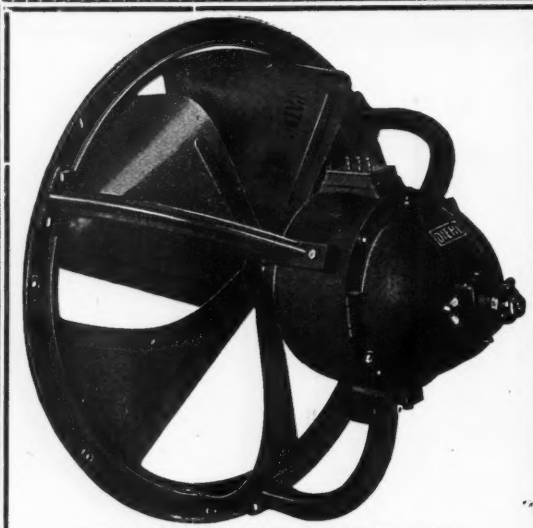

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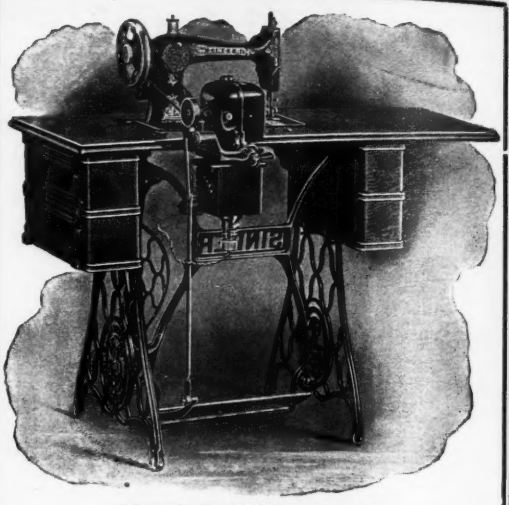

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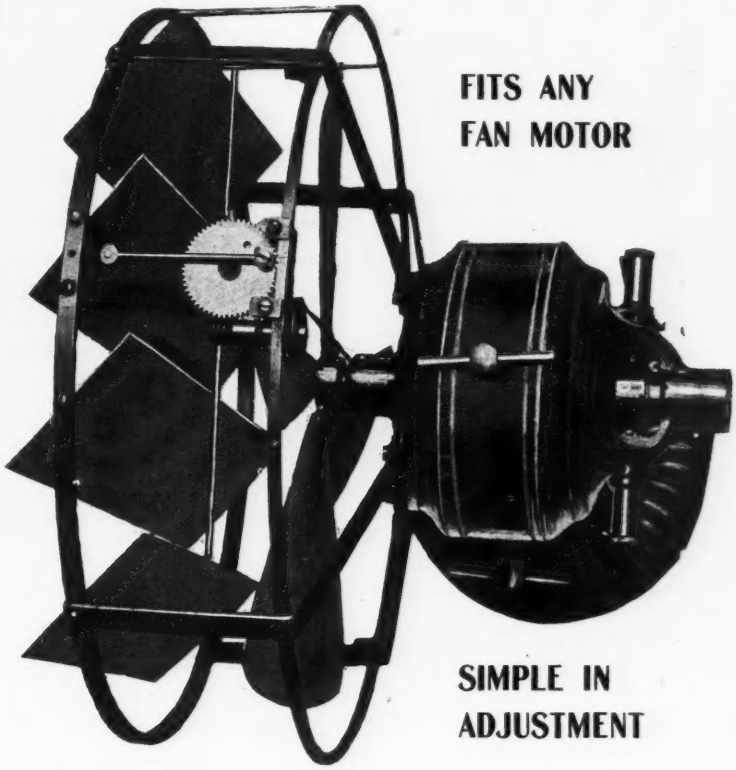

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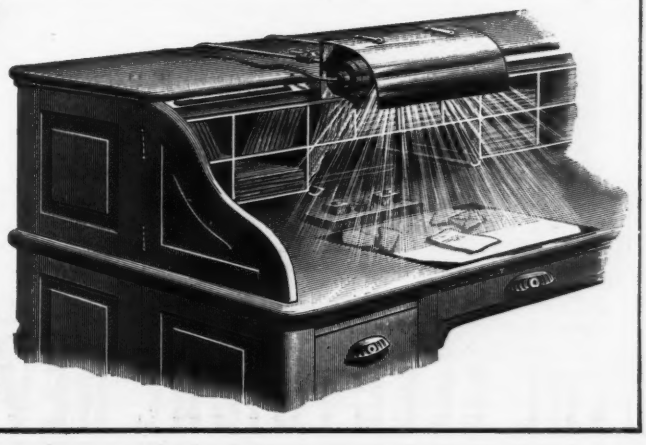

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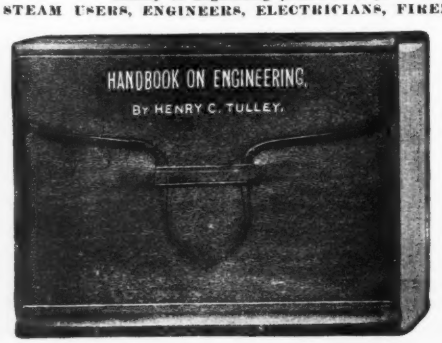

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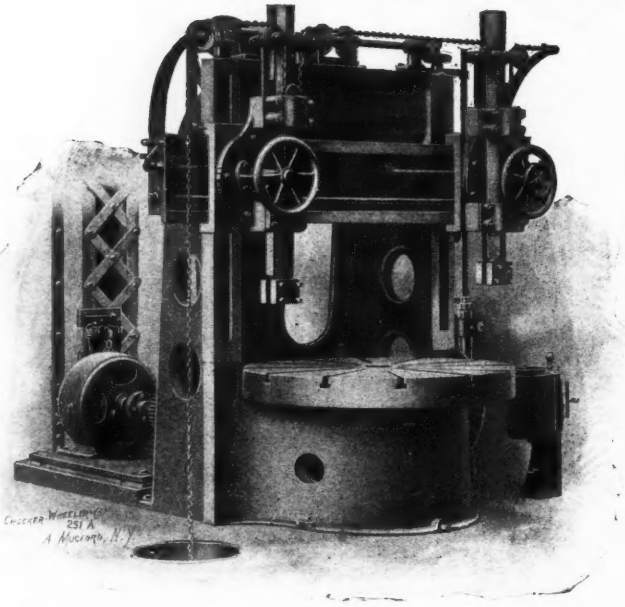

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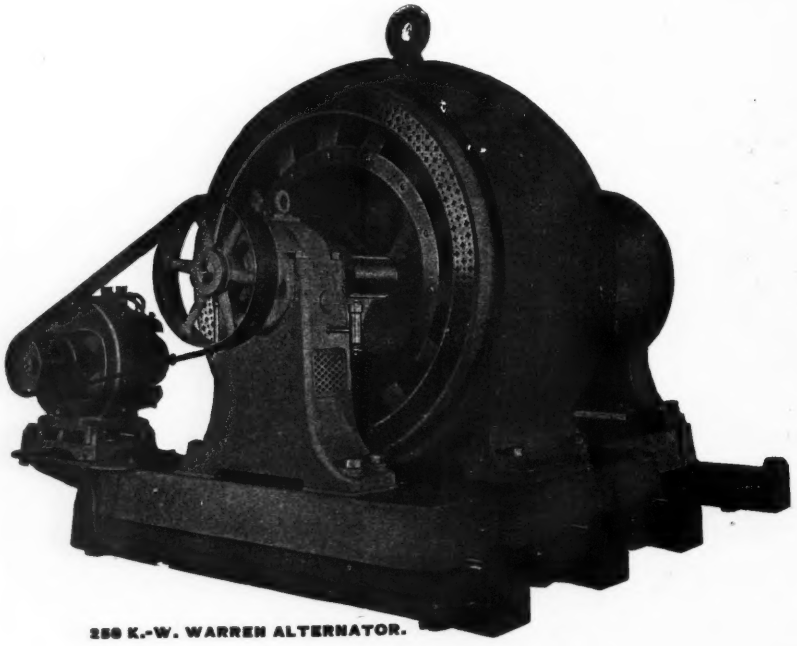

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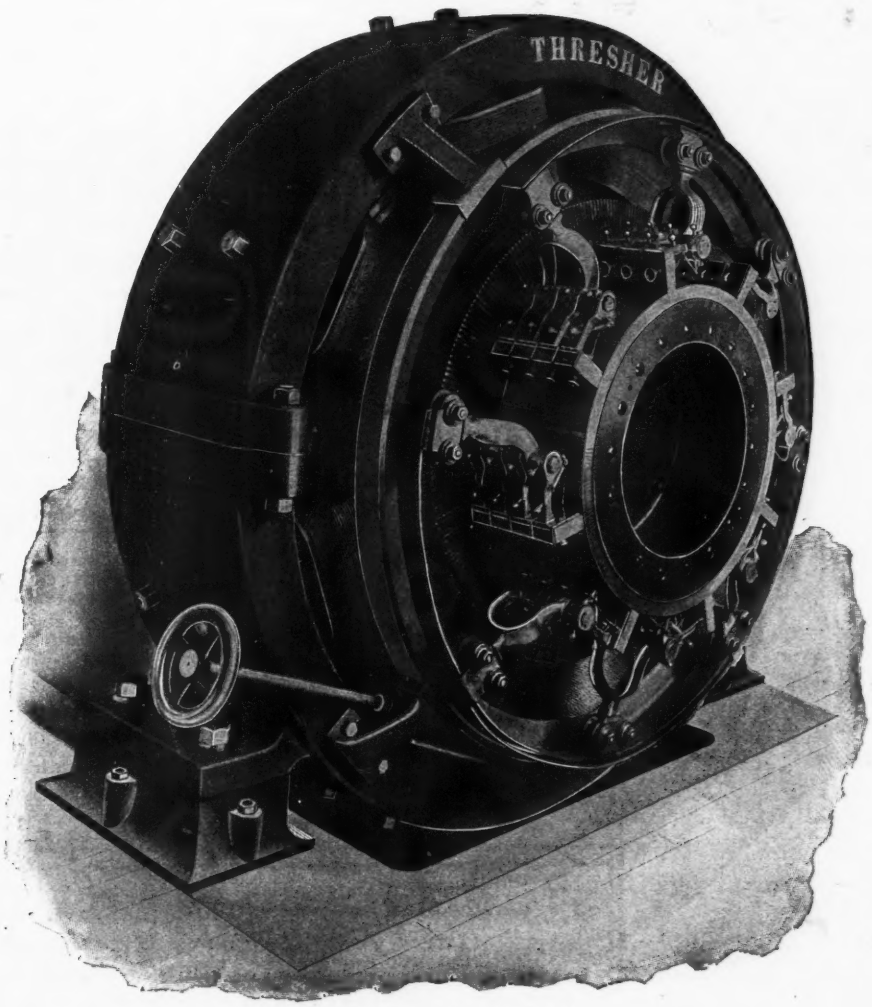

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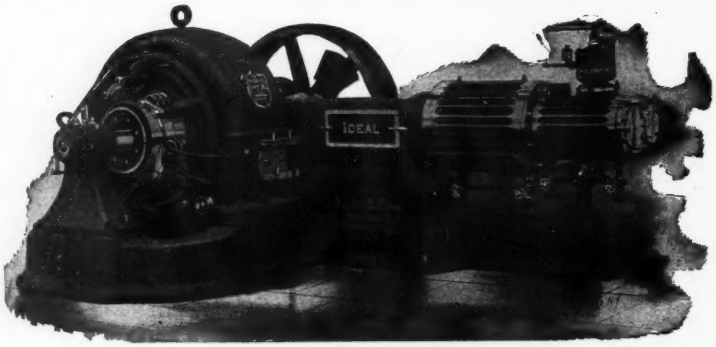

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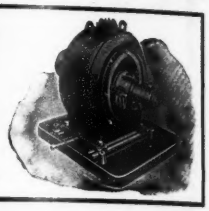

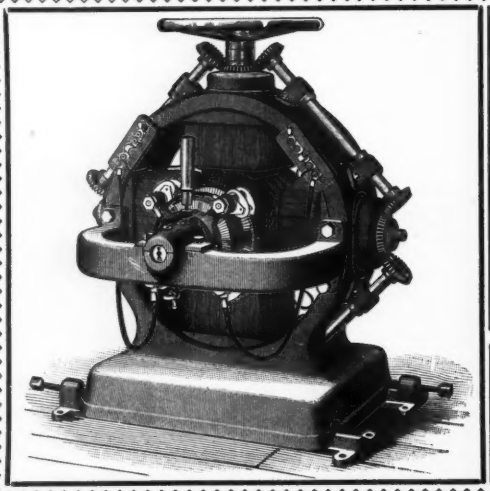

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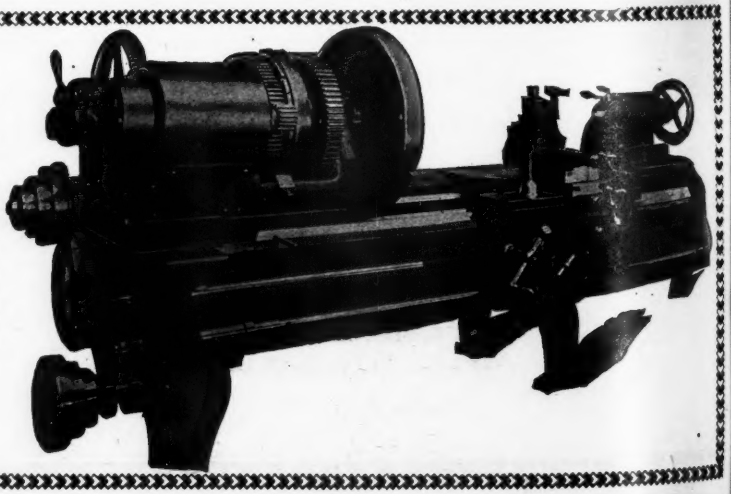

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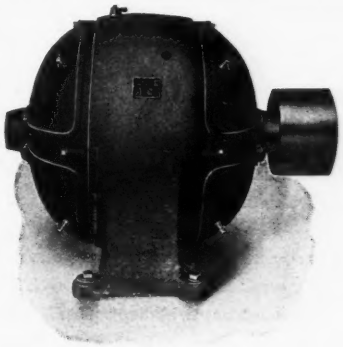

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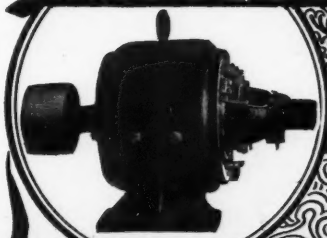

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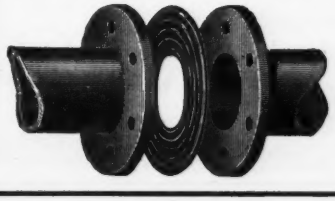

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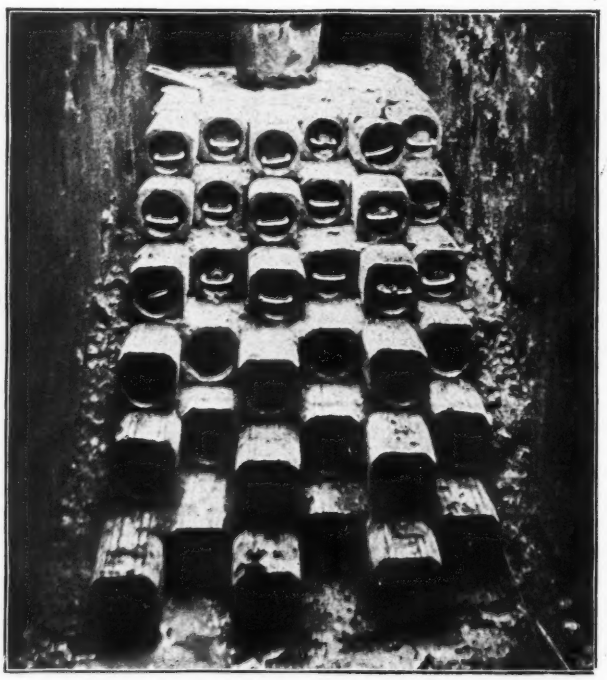

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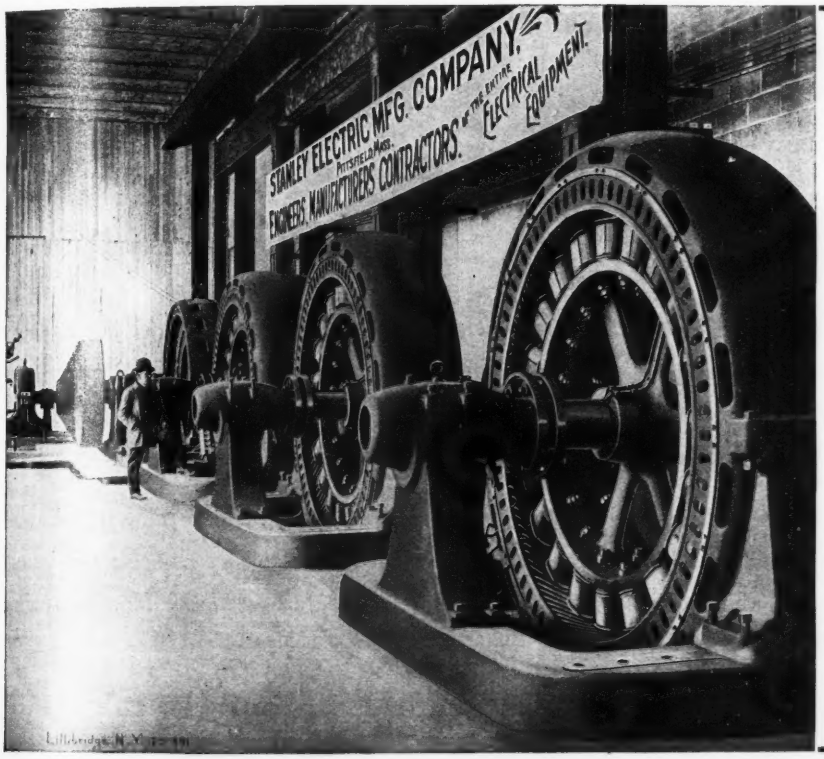

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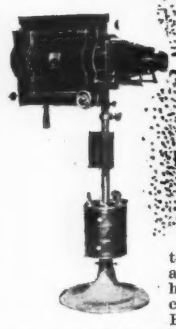

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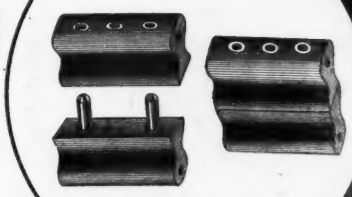

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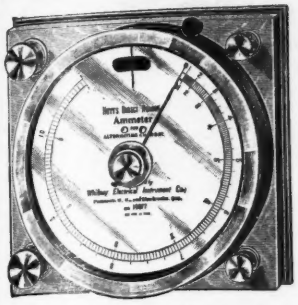

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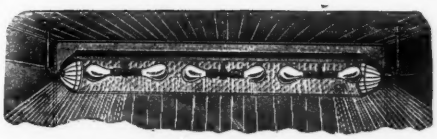

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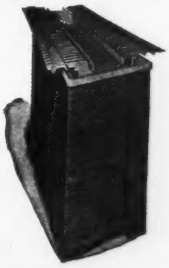

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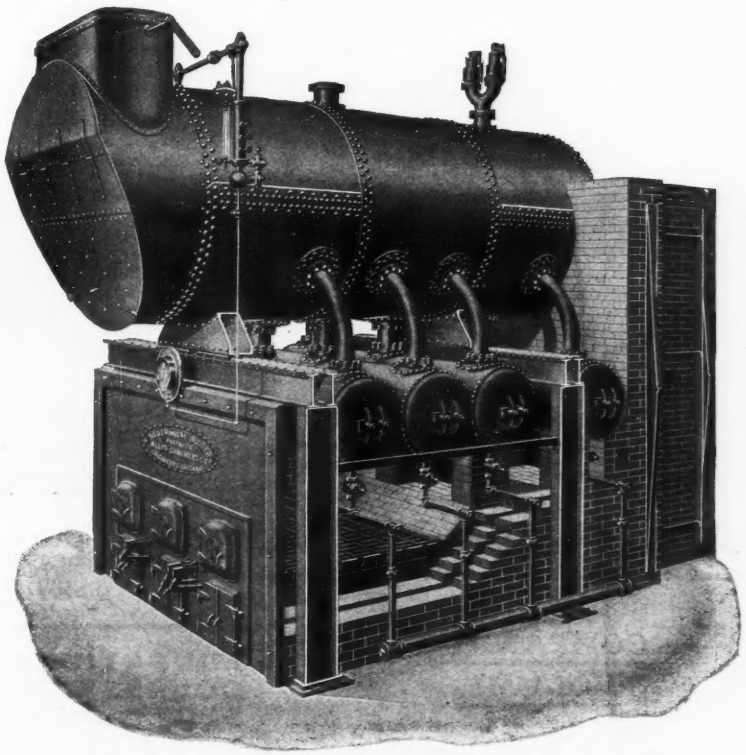

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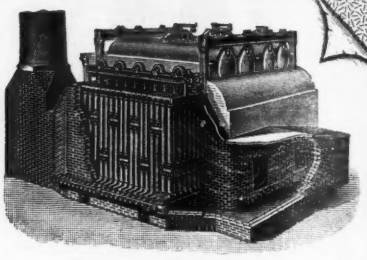

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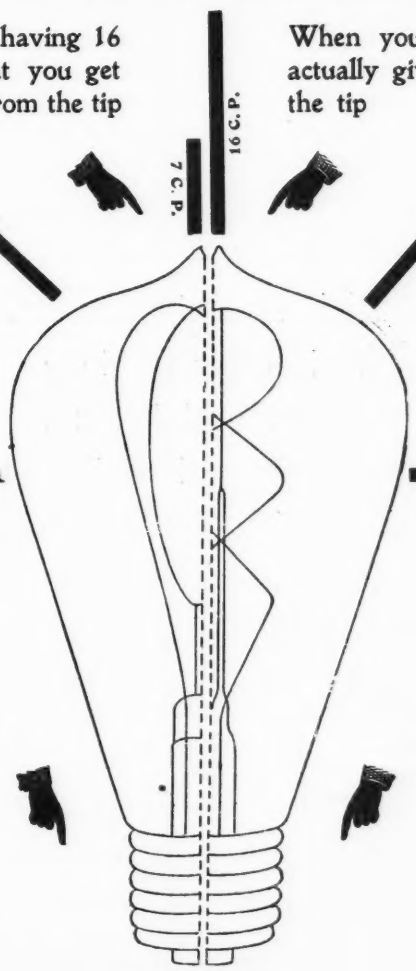

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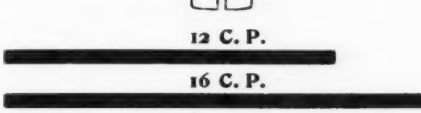

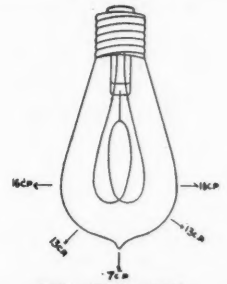

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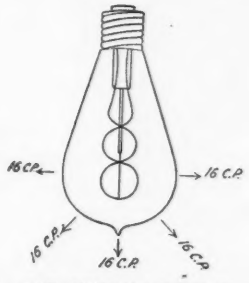

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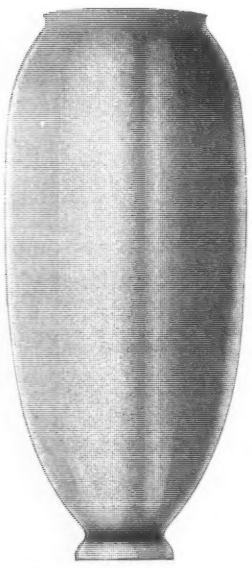

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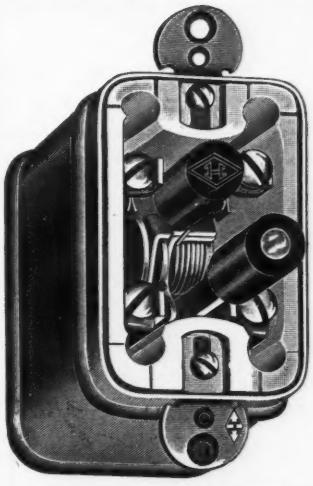

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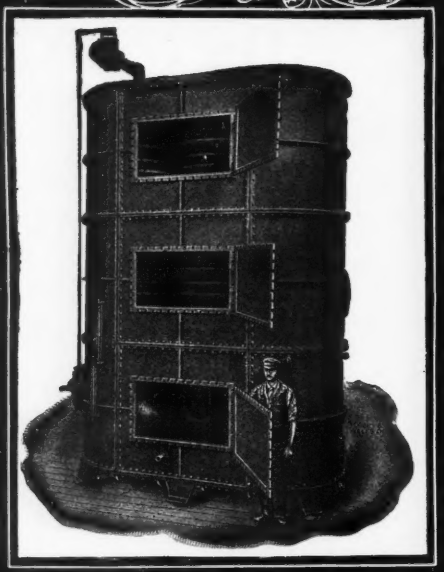

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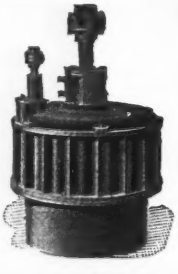

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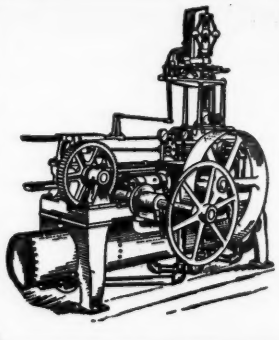

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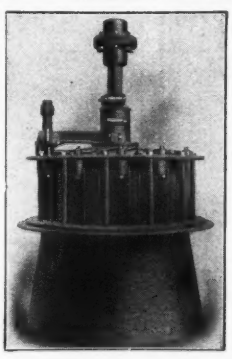

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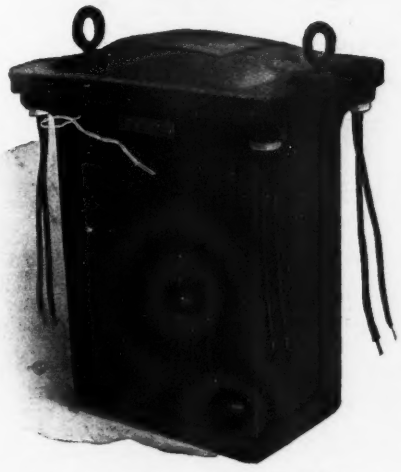

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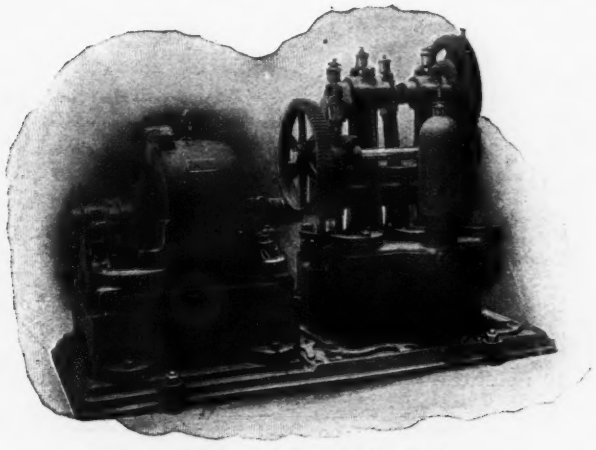

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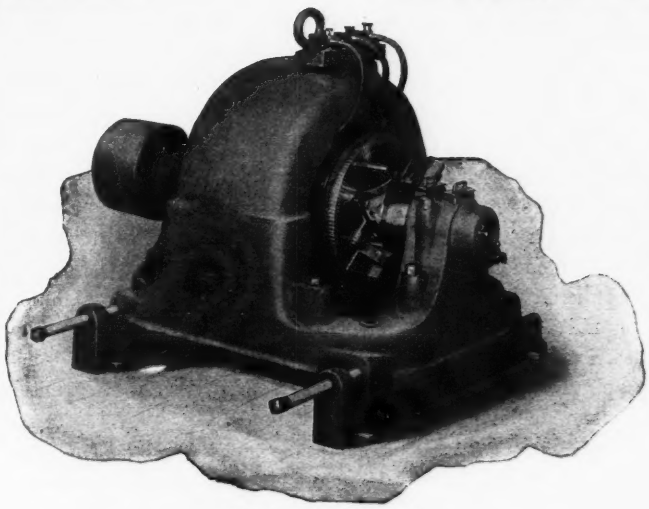

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SILVANUS P. THOMPSON, D. Sc., B. A., F. R. S., is regarded by all critics as the greatest writer on electro-technics known to electrical engineers. His remarkable genius in this direction manifested itself many years ago, when the science of electricity was just budding and little known that was not arbitrary, empirical, and in many respects useless as a means of further progress. There were many threads to be gathered up, composing the tangled skein of practice, and it required a discerning eye, an analytical mind, and a broadness of comprehension rarely met with, to weave together these broken threads of fragmentary experience and disconnected thought. It required the labor of a master of the science to present it, free from irrational conclusions, intelligible alike to the practical worker and theoretician. Professor Silvanus P. Thompson has made the subject of electro-technics his life study. He has presented it in so broad and connected a manner, with such masterly ability and perfection of description, that his work on Dynamo-Electric Machinery is acknowledged to be the greatest of all works bearing upon the principles, design, construction and operation of Dynamo-Electric Machinery.

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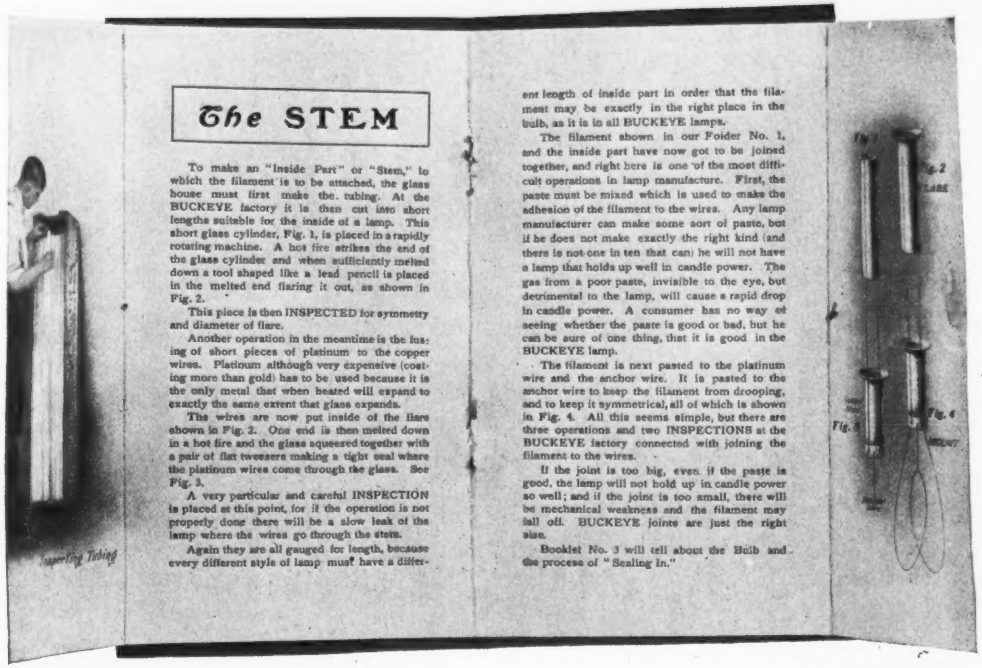
The STEM
To make an "Inside Part" or "Stem," to which the filament is to be attached, the glass house must first make the tubing. At the BUCKEYE factory it is then cut into short lengths suitable for the inside of a lamp. This short glass cylinder, Fig. 1, is placed in a rapidly rotating machine. A hot fire strikes the end of the glass cylinder and when sufficiently melted down a tool shaped like a lead pencil is placed in the melted end flaring it out, as shown in Fig. 2.
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Again they are all gauged for length, because every different style of lamp must have a different length of inside part in order that the filament may be exactly in the right place in the bulb, as it is in all BUCKEYE lamps.
The filament shown in our Foider No. 1, and the inside part have now got to be joined together, and right here is one of the most difficult operations in lamp manufacture. First, the paste must be mixed which is used to make the adhesion of the filament to the wires. Any lamp manufacturer can make some sort of paste, but if he does not make exactly the right kind (and there is not one in ten that can) he will not have a lamp that holds up well in candle power. The gas from a poor paste, invisible to the eye, but detrimental to the lamp, will cause a rapid drop in candle power. A consumer has no way of seeing whether the paste is good or bad, but he can be sure of one thing, that it is good in the BUCKEYE lamp.
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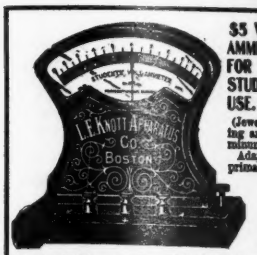

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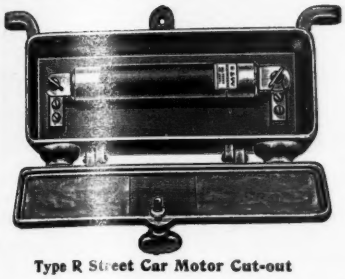

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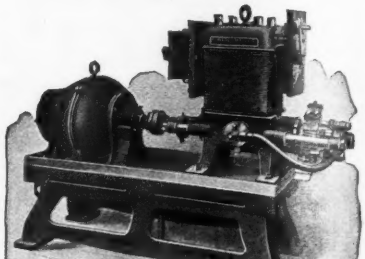

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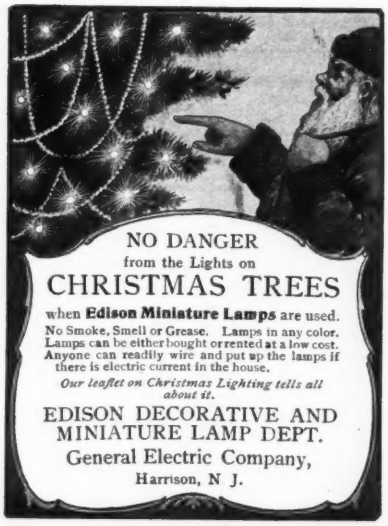

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714,680 Pay telephone; C. E. Egan, Durham, N. C.

714,681 Signal bell for telephone systems; C. E. Egan, Durham, N. C.

714,695 Electromagnet traction-increasing device; A. A. Honey, Tacoma, Wash.—A wheel, an idle wheel, a magnetizable bar extending between said wheels, and an electric coil or helix for magnetizing said bar and wheels.

714,718 Overhead conduit for electrical service wires; F. C. Locke, Boston, Mass.

714,721 Armature winding for electric motors or dynamos; R. Lundell, New York, N. Y.

714,734 Electric block-signal; E. M. North, Brooklyn, N. Y.

714,746 Electric railway system; W. Robinson, Boston, Mass.

714,756 Method of selective electric signaling; J. S. Stone, Boston, Mass.—The method of developing free or unguided simple harmonic electromagnetic waves of a definite frequency, which consists in producing forced simple harmonic electric vibrations of the same frequency in an elevated conductor.

714,759 Telephone system; A. F. Swan, Bayonne, N. J.

714,760 Electric annunciator-drop; E. G. Thomas, Cambridge, Mass.

(Continued on page 60.)

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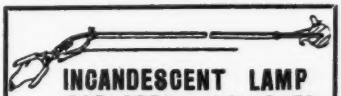

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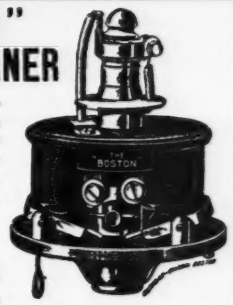

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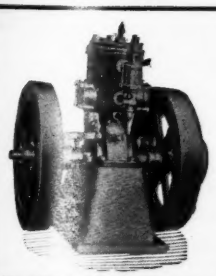

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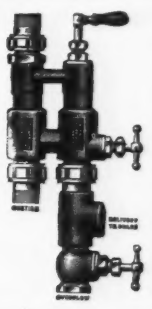

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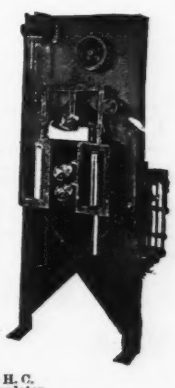

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PATENTS.

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714,769 Carbon-holder for dynamo-electric machines; C. Zabel, Edgewood Park, Pa.

714,775 Electrical process of locating running water in the earth; F. H. Brown, Los Angeles, Cal.

714,786 Controlling electric motor; M. W. Day, Schenectady, N. Y.

714,805 Boat; I. H. Larr, Sullivan, Ind.

714,810 Thermostat; A. T. Le Vesconte, Minneapolis, Minn.

714,811 Brush-holder; W. D Litchfield, Schenectady, N. Y.

714,813 Joint for telephone-transmitter arms; C. T. Mason, Sumter, S. C.

714,824 Process of starting induction-motors; A. Schwartz, Cologne, Germany.

714,831 Apparatus for selective electric signaling; J. S. Stone, Boston, Mass.—A system for developing free or unguided simple harmonic electromagnetic signal-waves of a definite frequency, an elevated conductor and means for developing therein forced simple harmonic electric vibrations of corresponding frequency.

714,832–834 Apparatus for and method of amplifying electromagnetic signal waves; J. S. Stone, Boston, Mass.

(*Continued on page 62.*)

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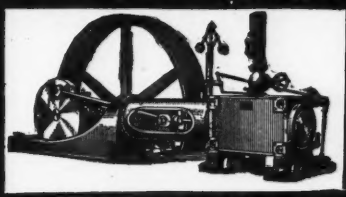

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714,851 Railway and car and magnetic appliances therefor; A. C. Albertson, New York, N. Y.

714,861 Process of electrolytic separation of copper and nickel; D. H. Browne, Cleveland, Ohio.

714,862 Controlling electric motor; H. W. Buck, Niagara Falls, N. Y.—A motor, manually controlled means for starting the motor, and a synchronous electromotive device which when in operation tends to stop the motor.

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714,891 Transformers and means for winding same; E. R. Gill, New York, N. Y.

714,893 Electric-current regulator; J. W. Hammond, Fredonia, N. Y.

714,904 Electromagnetic device; J. S. Hodges, Troy, N. Y.

714,905 Electromechanical clock; S. H. Hoggson, New York, N. Y.

714,913 Track-brake for electric cars; O. Keen, Allentown, Pa.

714,927 Rheostat; F. Mackintosh, Schenectady, N. Y.

714,928 Plug and receptacle; N. Marshall, Newton, Mass.

714,934 Means for preventing breakdown of high-potential windings; W. S. Moody, Schenectady, N. Y.—A winding for electrical apparatus, terminals for said winding, insulation of comparatively great dielectric strength for portions of the winding near a terminal or terminals, and insulation of less dielectric strength for other portions of said winding.

714,973 Measuring alternating electric currents; M. E. Thompson, Ridgway, Pa.

715,019 Means for synchronizing motors; F. E. Case, Schenectady, N. Y.—Motors in series with means actuated by an increase in electromotive force of any motor above that of others, for diverting current from such motor to the other or others.

715,043 Current-operated receiver for electromagnet waves; R. A. Fessenden, Manteo, N. C.

715,058 Electromagnetic brake; F. Harber, Washington, D. C.

715,071 Electric trolley protector; W. W. Hoffman, West La Fayette, Ind.

715,126 Rectifier for single or polyphase alternating currents; A. Nodon, Paris, France.

715,160 Magnetic separator; C. Scholl, Goppingen, Germany.

715,170 Hot-wire electric meter; R. S. Stewart, Detroit, Mich.

715,195 Method of synchronizing motors; F. E. Case, Schenectady, N. Y.—The art of regulating electromotors connected in series, which consists in simultaneously cutting down the current in any motor which slips and increasing it in that or those of lower speed.

715,203 Selective signaling by electromagnetic waves; R. A. Fessenden, Manteo, N. C.

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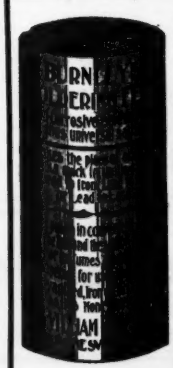

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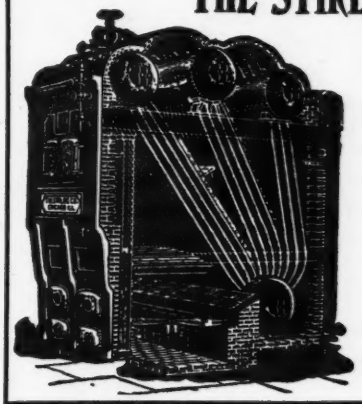

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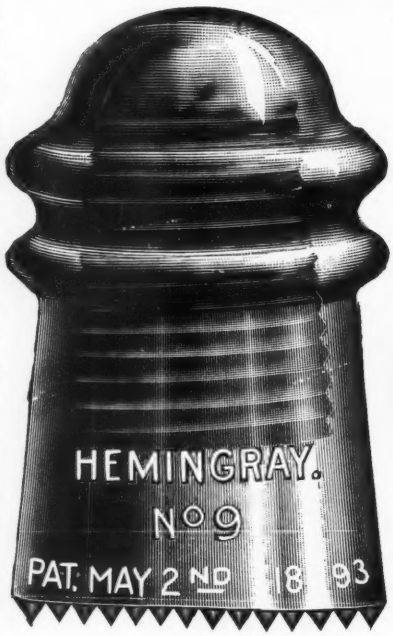

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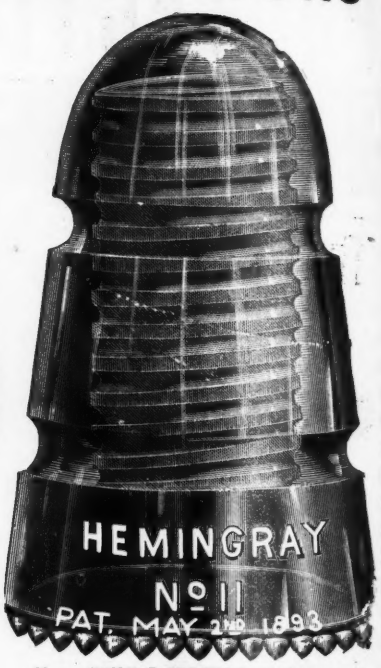

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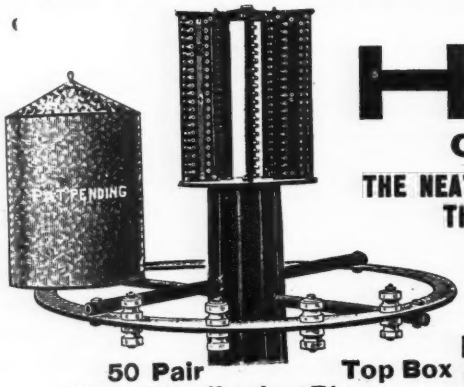

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New York

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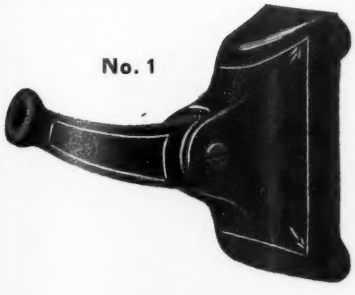

No. 7. (No. 11 is same style except larger)

No. 2

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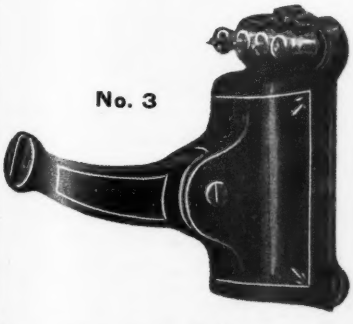
LARGEST STOCK

No. 3



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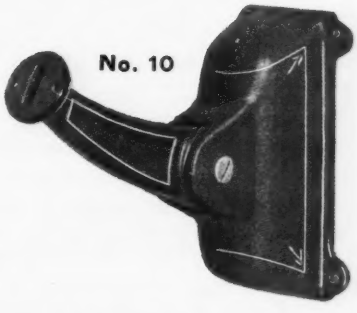

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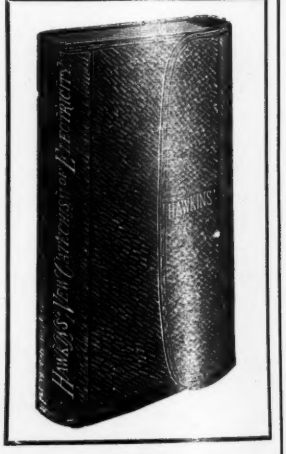
New Catechism of
ELECTRICITY



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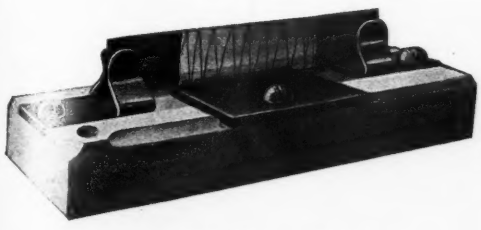
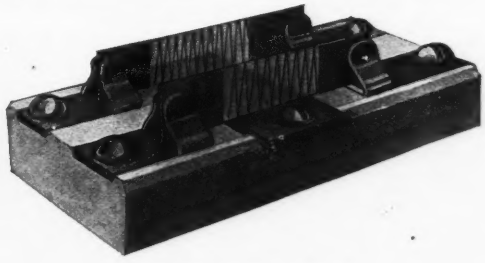


No. 10 Fuse Block, single line



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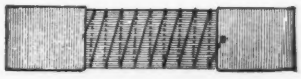

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Lunkenheimer Co., The

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(*Continued on page 70.*)

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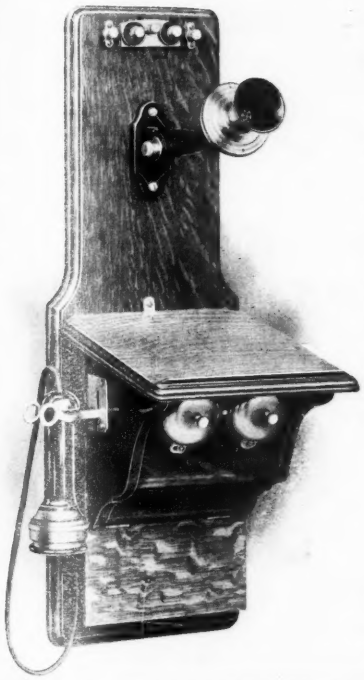

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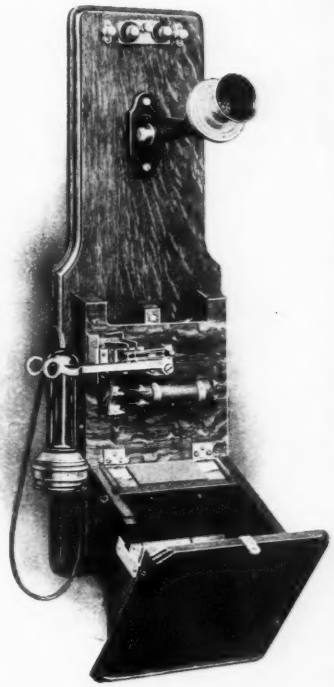

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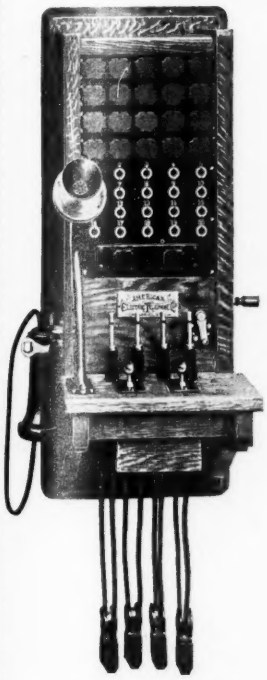

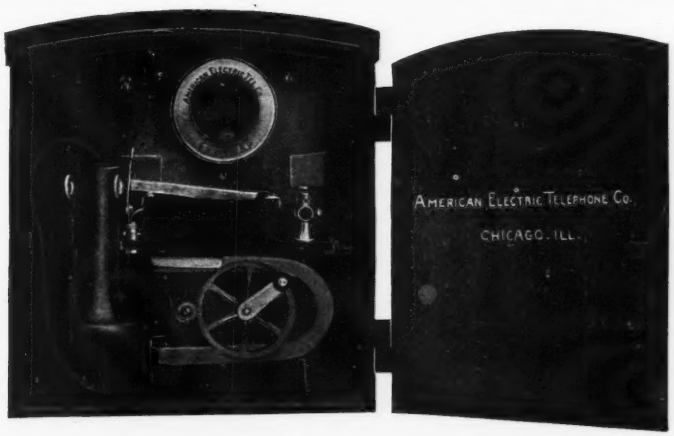

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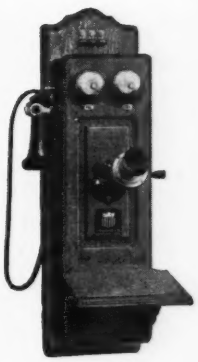

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Wagner Electric Mfg. Co.
Western Electric Co.

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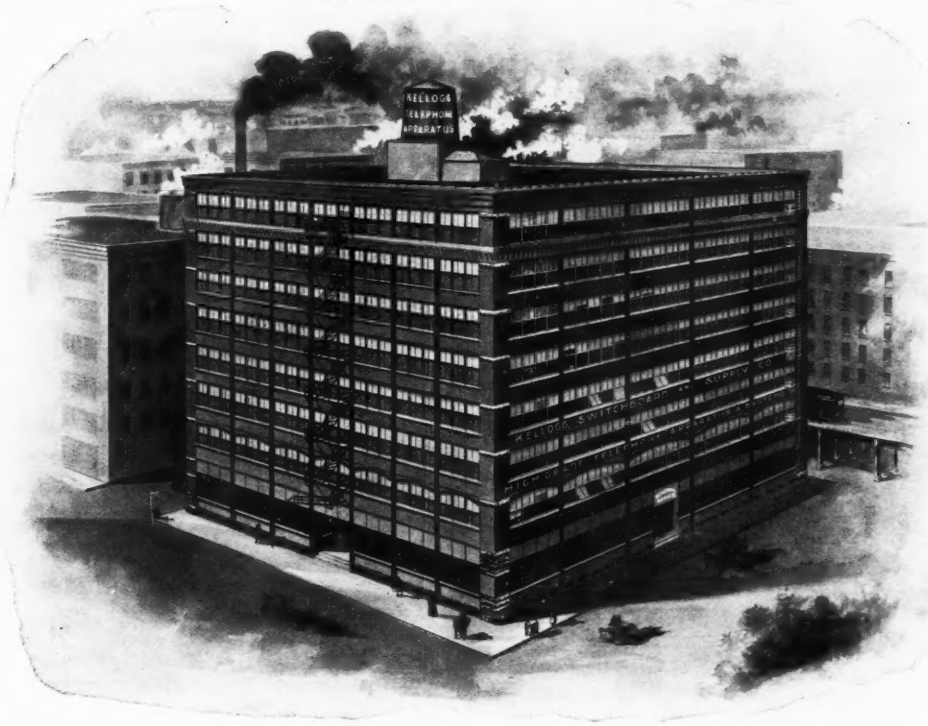

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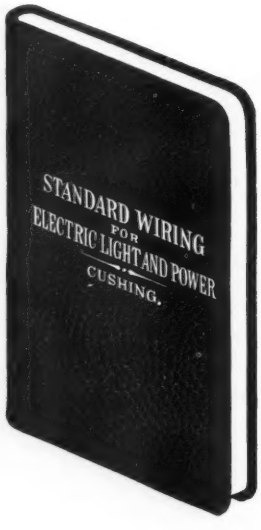

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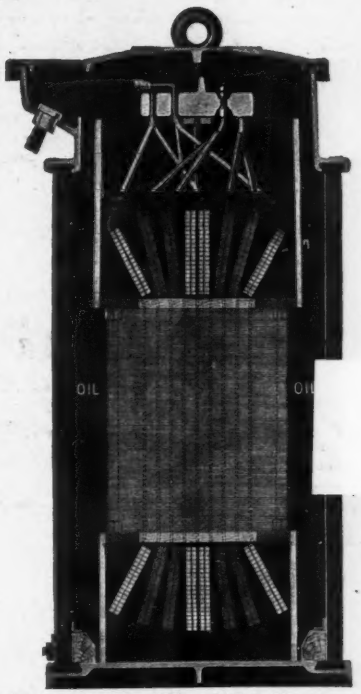
	58, 116, 232	116, 232, 464
2100	52½, 105, 210	105, 210, 420
	55, 110, 220	110, 220, 440
	58, 116, 232	116, 232, 464



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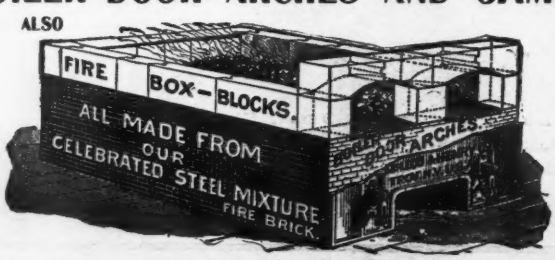

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